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RELIABILITY/MAINTAINABILITY/ LOGISTICS SUPPORT ANALYSIS COMPUTER AIDED TAILORING SOFTWARE PROGRAM (R/M/L CATSOP)

Rockwell International

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The objective of this effort was to develop a prototype expert system to improve tailoring of MIL-STD-785, MIL-STD-470 and MIL-STD-1388-1A to system acquisition needs. Specifically, CATSOP takes into account the information pertinent to system requirements, maintenance concepts, mission needs, acquisition phases, funding levels and use environment. This information provides a definition of scope, character and makeup of each task in each standard. The expert system is capable of providing guidance with respect to the above that experienced engineering specialists in reliability, maintainability and logistics are capable of providing in a consistent and repeatable fashion given the same set of program characteristics and needs.

R/M/L CATSOP, which runs on the M.1 Expert System Shell prompts the user with a series of system acquisition related questions. Each user response provides a pathway for applicable follow-on questions. Once the user has responed to all applicable questions, CATSOP determines and prioritizes all R/M/L tasks that are necessary

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for the acquisition program. The user than has the option to: add or delete tasks with CATSOP giving consequences of either, editing any previous inputs, or looking at the audit trail to determine why a given task was called out. CATSOP is written for the novice as well as the expert.

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RELIABILITY/MAINTAINABILITY/LOGISTICS SUPPORT ANALYSIS

COMPUTER AIDED TAILORING SOFTWARE PROGRAM

(R/M/L CATSOP)

EXECUTIVE SUMMARY

R/M/L CATSOP is a software development program to show the use of expert systems technology in the tailoring of Military Standards. The following three Military Standards were used in the development of this concept:

MIL-STD-785B	Reliability Program for Systems and Equipment Development and Production
MIL-STD-470A	Maintainability Program for Systems and Equipment
MIL-STD-1388-1A	Logistics Support Analysis

The product of the effort is a PC-based computer program that provides tailoring recommendations for the three standards. These recommendations are based on specific characteristics of the planned contract including application (space, airborne, etc.), Reliability, Maintainability, Logistics, and Diagnostic needs, maintenance concept, mission requirements, acquisition phase, funding levels, and risks. Full tailoring rules are complete in the model for all tasks applicable to the Concept Development acquisition phase (69% of all tasks/sub-tasks).

In addition to the tailoring recommendations, the program contains all of the user functions expected of a final tailoring model. These include user friendly menu instructions and questions, the ability to stop and resume a tailoring session or change a previous session, hardcopy outputs, and complete audit trails.

WHY R/M/L CATSOP

Today's Military Standards are specifically written to cover a broad range of applications with the intent that they be tailored to each specific application. All tasks are not applicable to any one contract. Additionally the applicable tasks may vary in depth and width according to the application.

Each Standard includes some direction as to how the tailoring should be performed. In spite of this, the tailoring remains a subjective task. The same results will not necessarily be achieved from any two people. Differences in tailoring come from differences in the perspective of the one doing the tailoring and the information and time available. Compounding the perspective problem, each specification is often tailored independently by individual experts in each of the three fields. This may result in overlapping requirements from each of the standards. More often, tasks are tailored out of one standard not considering that its data is required to perform an included task from another standard. If an attempt is made by one person to integrate the process, he typically will have biases toward one area or another.

In reality, tailoring is often done by simply extracting work statements from previous contracts. This obviously does not guarantee a good match to the new contract.

R/M/L CATSOP circumvents the above problems. R/M/L CATSOP rules represent a consensus of many experts in each of the three fields related to how the standards should be tailored under various conditions. The action taken by these rules in each tailoring session is based on a specific set of input information determined to be that which most influences the tailoring process. Linkages between tasks are checked to assure completeness yet eliminate redundant efforts.

The basic R/M/L CATSOP output is a list of tasks to be performed with statements qualifying the work to be done when applicable. Supplemental information is also provided. This includes a ranking value by task, which defines the task importance under the input conditions. Also, information required of the contracting authority in order for the task to be accomplished is listed, if desired.

A TYPICAL USER R/M/L CATSOP TAILORING SESSION

R/M/L CATSOP tailoring sessions may take many forms. The user session may be a continuation of a previous session, a modification of a previously completed session, or a completely new session.

The R/M/L CATSOP title banner is followed by the CATSOP Option Menu, which identifies four options:

0. EXIT CATSOP
1. Tailor New Program
2. Revise Previously Tailored Program
3. Resume a Previous Session.

Selection of Option 1, "Tailor New Program", starts a new tailoring session from the beginning. The session then progresses as follows.

Reference Information R/M/L CATSOP asks the user for information such as Date, Program Name, Contract Number, etc. This data is printed on the output reports for identification purposes. Later, if the user wants to save the tailoring information from a session, he is prompted for a save file name. He is also asked which standards he wants to tailor.

Tailoring Information A series of multiple choice and numeric questions follow, the answers to which provide the basis for the tailoring. A total of 16 questions have been defined for this purpose, all of which may not be asked in a given session based on answers previously provided. These questions include inquiries about the program phase, the application, the amount of new design, the hardware criticality, budget, schedule, specification challenge, and previous work accomplished.

Output Options The tailoring is performed after the entry is made to the last question. The user is then offered the following options:

0. Exit User Options
1. Display Results
2. Edit Answers
3. Override Tailoring Results
4. Tailoring Inquiries
5. Save Results

The results displayed by selecting option 1 are a list of tasks to be performed and a narrative explaining the extent to which the task is to be accomplished. Each task is ranked defining its importance under the defined conditions. A secondary option is also provided, which lists the information required from the contracting authority to perform each task.

R/M/L CATSOP DEVELOPMENT ACTIVITIES

R/M/L CATSOP development was performed by personnel experienced in using information from and performing the program tasks of all three of the MIL Standards. Over 180 years of direct R/M/L experience were represented in the CATSOP team. In addition, the software development portion was performed by Expert Systems/Software design personnel constituting another 9 years of direct experience.

Five major efforts were included in the R/M/L CATSOP development as summarized in the following paragraphs.

Determination of Tailoring Criteria The initial development task was to determine what really makes a difference in the tailoring process. Many factors were obvious and readily agreed to by the team. These included items such as program phase, budget, amount of development to be done, and criticality (including number to be deployed). Other factors were identified but their actual impact on tailoring required research. One example from this category is maintenance concept. For this example, research determined that the only maintenance concept of any significant consequence was repair or discard.

Definition of User Questions Wording of questions that could be understood and answered by the user was of great importance. Questions had to be written that solicited information determined to impact the tailoring. Each question required multiple choice or numeric answers. Explain screens were also developed to assist in understanding the questions. One of the more difficult questions to structure was requirement difficulty. Possible alternatives evaluated included questions that asked for numeric values of the specified MTBF, repair times, etc., and various forms of more qualitative descriptors. Qualitative wording was selected describing the design difficulty expected in achieving the requirements.

Rule Development Directly associated with the preceding two tasks was the structuring of the tailoring rules. These are the rules that translate the answers given by the user to the resultant tailoring of the MIL-Standards. Rules were developed to eliminate tasks, apply qualifying notes to tasks, and rank tasks.

Software Engineers provided the coding of the rules for computer application. A commercial expert system shell (Tecknowledge M.1) was used as the application package.

Man-Machine Interface Implementation R/M/L CATSOP has numerous characteristics to assure its usability. These include the ability to change answers, provide assistance, interrupt a session, print hard copies, input data without a query, override tailoring recommendations, and provide an audit trail of all actions taken and decisions made.

Testing Testing of R/M/L CATSOP has been completed to assure consistency and the working of all Man-Machine interface features. Additional testing and amplification of the tailoring rules is a suggested follow-on effort.

CONCLUSIONS AND BENEFITS

Expert Systems methodology can be implemented on personal computers for easy and consistent tailoring of Military Standards. Programs defined by such tailoring represent the experience and consensus of many experts. They have no conflicting requirements nor do they include nonproductive tasks.

Manpower required to perform the tailoring is significantly reduced. More importantly, however, the Life Cycle costs of the program thus defined are reduced and the potential for a more effective product is increased due to a more optimum design program.

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1.0 INTRODUCTION

R/M/L Computer Aided Tailoring Software Program (R/M/L CATSOP) is a PC-based software package that determines the appropriate tailoring of Reliability, Maintainability, and Logistics Support Analysis program requirements for a specific application. R/M/L CATSOP is designed to permit Program Managers or other contracting personnel to develop an integrated set of appropriate R/M/L program task requirements to be imposed on a given program. The Program Manager or other RFP technician can define these requirements without the aid of specialists from the stated areas. Actual tailoring time, excluding any time for data research, is typically less than 30 minutes.

The development of R/M/L CATSOP was prompted by difficulties arising from manual tailoring efforts. Without R/M/L CATSOP, one or a combination of several tailoring approaches are occurring, all generally leading to less than optimum tailoring. These sub-optimum tailoring approaches include: 1) doing it the same as was done on another contract, 2) using boilerplate generalities, and 3) spending excessive time using "experts" from each discipline to separately tailor each specification. Typical shortcomings from these approaches include excessive use of resources, redundant or otherwise unnecessary tasks, the elimination of tasks required to perform other tasks, and/or confusing directions.

This report describes R/M/L CATSOP and the effort expended in its development.

2.0 PROGRAM OBJECTIVE

The contract objective of the effort reported in this document was to design an expert system to improve the tailoring processes for the following three Military Standards.

MIL-STD-785B	Reliability Program for Systems and Equipment Development and Production
MIL-STD-470A	Maintainability Program for Systems and Equipment
MIL-STD-1388-1A	Logistics Support Analysis

This capability was to be developed to a pre-prototype level sufficient to prove the validity and usefulness of the design. The product was to:

- provide a structure with a complete and user friendly man-machine interface.

- contain a knowledge base of rules sufficient to consider task linkages and programmatic factors, which determine the applicable tasking.

- be usable and respected by differing skill levels.

- be easily modified and expandable to incorporate additional rules/methodology.

All of the above objectives are met or exceeded by the current R/M/L CATSOP. It is a complete working tool i.e., it performs all of the functions intended of a final product. It can now be used to tailor all three standards. It is only incomplete in regard to the set of tailoring rules it contains. R/M/L CATSOP currently contains full tailoring rules for all tasks identified as applicable to the Concept Development phase plus a few tasks unique to some of the other phases. All other tasks have only limited rules at this time. Details describing the tasks covered by a full rule set and the R/M/L CATSOP operational features are contained in sections 3.5 and 4.0 of this report, respectively.

3.0 DEVELOPMENT PROGRAM OVERVIEW

The development of R/M/L CATSOP was structured to involve people from many disciplines over a sufficient time period to allow required coordination. Talents of people with many years of experience in all software and R/M/L related disciplines were employed.

Tasks accomplished by the above personnel were also varied. The initial effort was to identify what factors determine R/M/L tasks to be accomplished for any specific program. Rules were then developed and implemented based on those factors. User interfaces were developed to provide desired features such as the ability to revise previous sessions and determine the impact of overriding CATSOP recommendations. Finally, the results were all described in appropriate Software Documentation (see Section 3.8) and this final report.

3.1 USE OF "EXPERTS"

The basic concept of CATSOP and Artificial Intelligence/Expert Systems is to capture the consensus of experts such that non-experts can utilize it for decision making. Experts from Reliability, Maintainability, Logistics Support Analysis, Diagnostics Development, Integrated Logistics, Life Cycle Costing, Artificial Intelligence, Computer Mechanizations and Interfaces, and Software Development pro ·ided input and/or review functions for R/M/L CATSOP. Appendix F contains brief resumes of the personnel involved in the development.

A data base was developed to store and sort the expert knowledge. An expert information data base file was created for each MIL-Standard task/sub-task. Records describing data inputs and outputs, alternative approaches, task importance, selection criteria, qualifying notes and application criteria, etc., were completed in each file by the appropriate experts. The use and content of this data base is described throughout the remainder of this section.

3.2 TAILORING FACTORS

The single most important development for R/M/L CATSOP was the tailoring criteria, i.e., what information determines the R/M/L tasks to be accomplished for a specific program. To make CATSOP a usable tool, it is important that the information required of the user in a tailoring session completely defines all impacting variables and yet be limited in amount. In addition, this information must be requested concisely and to the point, be understandable, and be answerable by a non-expert. Development of the questions R/M/L CATSOP asks of the user received a significant amount of attention by the Experts and RADC personnel.

3.2.1 Tailoring Criteria Selection The tailoring criteria were established early in the R/M/L CATSOP development. They were initially documented by discussing with various experts the question, "What are the factors which determine which tasks to be accomplished." A review of the tailoring information of the MIL-Standards was also completed. A composite list was compiled from these investigations, which formed the basis of the early tailoring rule development. This list was discussed in various meetings including the three oral reviews held with RADC. Some revisions were suggested from the meeting discussions. A few additions were made during the early rule development effort. However, the list currently mechanized in R/M/L CATSOP is very close to the one first developed.

There are 16 question subjects in the currently mechanized list. These subjects and their use are described in Table 1. The answers given to these questions in a given tailoring session provide the information upon which the tailoring is accomplished. Some questions are not asked if other answers make them not applicable.

The answers given to the questions are used in the tailoring process in three different ways listed below. Table 1 also identifies how the data from each question is used.

1. Questions directly related to task tailoring. The information input from these questions directly determines if and to what extent a task should be performed.
2. Questions related to task importance. Task ranking is developed from the information received from these questions.
3. Check questions. A few questions are asked to make sure that the previous questions and possible answers were understood by the user.

The following paragraphs discuss each of the question subjects listed in Table 1 and the rationale behind their selection.

Program phase is a basic tailoring criterion described in the MIL-Standards. Each program phase is characterized by different objectives, hence different tasks to be performed and different levels of details for each task.

The Contract Objective question is used for check purposes only. Sometimes the officially stated program phase does not correlate to the real objective of the work being accomplished. If an objective is selected that does not correspond to the entered program phase, the user is queried to make sure a more representative program phase is selected.

TABLE 1 R/M/L CATSOP Program Definition Question Subjects

QUESTION SUBJECT		QUESTION USE CATEGORY		
		DIRECT TASK TAILORING	TASK RANKING	CHECK QUESTION
01	PLEASE IDENTIFY THE PROGRAM PHASE FOR THE CONTRACT FOR WHICH THE SPECIFICATIONS ARE BEING TAILORED	*		
02	SELECT ONE OF THE FOLLOWING WHICH BEST DESCRIBES THE OVERALL OBJECTIVE OF THIS CONTRACT			*
03	SELECT ONE OF THE FOLLOWING WHICH BEST DESCRIBES THE OBJECTIVE OF THIS CONTRACT SO FAR AS DEVELOPMENT OF SUPPORT CHARACTERISTICS ARE CONCERNED	*	*	
04	THE HARDWARE LEVEL TO BE CONTRACTED FOR IN THIS PROCUREMENT IS:	*		
05	IS THE EXPECTED MAINTENANCE CONCEPT TO BE DISCARD AT FAILURE?	*		
06	WHAT BEST DESCRIBES THE HARDWARE WHICH IS THE SUBJECT OF THIS CONTRACT? (AMOUNT OF NEW DESIGN)	*	*	*
07	WHAT BEST DESCRIBES THE APPLICATION OF THE HARDWARE WHICH IS THE SUBJECT OF THIS CONTRACT? (HOW NEW)	*	*	
08	THE PLANNED QUANTITY OF CONTRACT "END ITEMS" TO BE PRODUCED UNDER THIS CONTRACT ARE:			
09	THE TOTAL ULTIMATE QUANTITY OF CONTRACT "END ITEMS" EXPECTED TO BE FIELDED ARE:	*	*	
10-12	EXPECTED PROGRAM BUDGET IS:	*		*
13	THE PROJECTED OVERALL SCHEDULE FOR THIS CONTRACT IS CONSIDERED TO BE:	*	*	
14	THE EQUIPMENT WHICH IS BEING PROCURED/DEVELOPED UNDER THE SUBJECT CONTRACT WILL BE USED IN WHICH OF THE FOLLOWING:	*	*	
15	CATASTROPHIC FAILURE OF THE CONTRACT EQUIPMENT WILL RESULT IN:	*	*	*
16	WHICH OF THE FOLLOWING SPECIFICATIONS HAVE BEEN ESTABLISHED FOR THE EQUIPMENT WHICH IS THE SUBJECT OF THIS CONTRACT?	*	*	*
16X	INDICATE THE EXPECTED DESIGN DIFFICULTY IN THE ATTAINMENT OF THE ESTABLISHED SPECIFICATION REQUIREMENTS	*		*
17 - 20	PLEASE IDENTIFY ANY OF THE FOLLOWING TASKS WHICH HAVE BEEN COMPLETED FOR THIS HARDWARE, AND THE RESULTS OF WHICH ARE AVAILABLE TO THIS CONTRACT:	*		

Contract objectives related to the development of Support Characteristics theoretically should have a direct correlation to the program phase or overall contract objective. However, experience has shown this is not always the case in the real world. This specific input is requested to determine if these objectives are consistent with the phase objectives.

Many tasks of the LSA are applicable only at weapon system or system levels. Reliability and Maintainability tasks are more generally applicable at all hardware levels. However, the scope and direction of these tasks differ as the hardware levels change, hence the need to specifically identify the hardware level of the procurement for which the standards are being tailored.

Discard or repair significantly impacts the maintainability tasks to be performed and has no impact on reliability tasks. Obviously, if an item is discarded upon failure, no effort is required to assure that it can be repaired. This is the only aspect of maintenance concept found to impact the tailoring of any of the three standards.

The MIL-Standards describe the "opportunity to change" as a tailoring criteria. This is defined as the "freedom to change" and the "ability to change". For R/M/L CATSOP, these factors are mainly captured in terms of the amount of new design in the hardware and the hardware application. A separate question is asked for each of these two areas (hardware and application) in terms of it existing, being modified, or new.

The quantity of items to be produced under this contract is an identifier of resources. Demonstration and testing tasks may have to be limited if resources are restricted. This input may also provide indications as to scheduling of the tasks should that become a part of R/M/L CATSOP.

The ultimate quantity of items to be fielded provides insights into the importance of supportability features and the establishment of design requirements. This question couples with answers to the use of the equipment and the criticalness of a failure.

Program Budget and Schedule should not be determinants of what tasks are required to achieve required results. The realities of the situation, however, are that programs need to be structured to fit within given budget and schedule constraints. R/M/L CATSOP does consider these factors and eliminates tasks of lesser importance if necessary. (A more thorough discussion of this question is presented as an example of question wording in paragraph 3.2.2 below.)

The planned use of the equipment helps identify the significance of the expected fielded quantity. One manned spacecraft obviously is of greater significance than one manpack item. The use of the equipment also provides information as to the criticalness of the item and applicability of certain tasks.

Knowing the result of a system failure describes how important the system is in its application. This input is used in determining the ranking of the Reliability and Maintainability tasks.

A major number of the LSA tasks are directed toward the establishment of requirements. If specification values have been established, these tasks are not required.

The expected design difficulty to achieve the stated requirements is another assessment used to rank the importance of the tasks. If it is expected that design requirements will be achieved with little or no effort, then the importance of oversight tasks is minimal. Only the tasks that measure the result are necessary.

The identification of completed tasks prevents the requiring of those tasks again. Some tasks such as the monitoring of subcontractors are never considered completed as long as the task is applicable. The previous effort status of these tasks is not asked.

There were a few other factors/descriptors considered as possible tailoring criteria but not selected. These included the following:

Maintenance Concept - Differences in maintenance locations/levels has a big impact on logistics developments and maintenance resources. They do not, however, have an impact on the tasks to be performed to develop them, i.e., the MIL-Standard tailoring.

LSA Record (LSAR) Requirements - There was some initial discussions regarding factors that impact the LSAR tasks. It was determined that none of these impacted the MIL-Standard 1388-1A tasks and MIL-Standard 1388-2A was not being covered under this development.

Design Challenge - It was determined early that the difficulty of achieving design requirements was a tailoring criteria. It is included in the questions as design difficulty as discussed above. Other approaches investigated but not selected included the input of the actual quantitative requirements and a direct comparison to a previous program.

Subcontractor/Supplier Involvement - Some tasks are imposed only if there are Subcontractors/Suppliers that are actively involved in R/M/L issues. This topic was rejected as a tailoring criterion, however, since it typically is not fixed at the time of preparing an RFP.

3.2.2 Question Wording All questions are asked with multiple choice, numeric quantity input, or yes/no answers. Appendix A contains a sample user session which shows the exact form/wording selected for most of the questions.

In some instances, the wording of the questions and answers are straightforward. For example, one important question is the program phase. The wording and list of possible answers for this question were taken directly from the MIL-Standards.

In other instances, the question wording required significant consideration. Perhaps the most controversial question deals with the expected program budget. Alternative methods investigated for dealing with budget included asking for the actual dollar amount, asking for the number of personnel to be assigned in the Contracting Authority office, or asking for a relative budget level. The latter alternative has several sub-alternatives dealing with the number of increments and wording to be used in defining the relative levels.

The solution selected is as follows. Questions in the following format are asked for each of the three program areas.

> The expected Reliability (MIL-STD-785) budget for the program is:
> 1. Normal
> 2. Limited
> 3. Very Limited

Many argue that the above definitions are vague and that the Program Manager attempting to use CATSOP would not know the correct answer. The Expert consensus is, however, that:

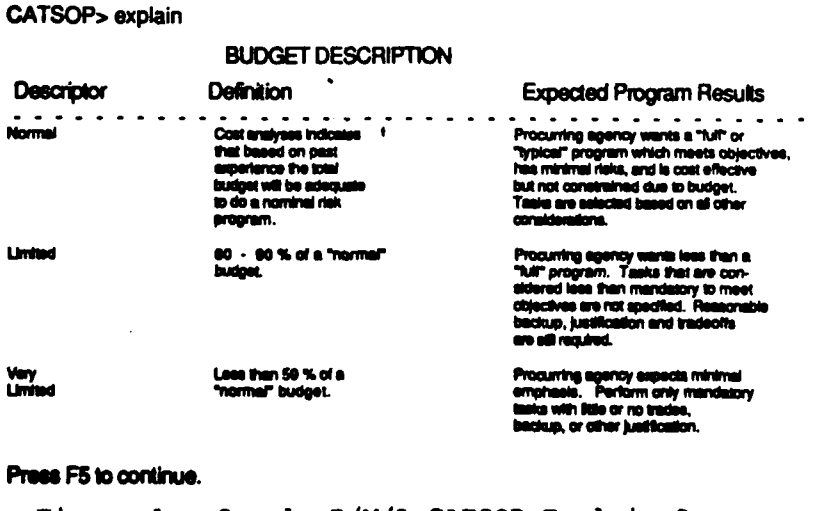
> 1) Budget really relates to emphasis and importance. This question is actually asking what is the emphasis to be placed on Reliability? Is it normal, limited, or very limited. Typically, the Program Manager does know how important achievement of the Reliability requirements is to him. (The next section of this report discusses HELP screens that are provided with each question to aid in its understanding. The help screen for this question is contained in Fig. 1. This figure shows how the HELP describes the relationship between budget and emphasis.)
>
> 2) There is generally an air or mood in a proposal phase regarding the constraints of the program. If requirements are difficult, it is generally known. If schedules are impossible or budgets are tight, these things are known or at least felt. Thus, the consensus is that the R/M/L CATSOP user would have a feel for the appropriate answer to budget limitations expressed in the above terms.

An approach using absolute dollar values was not selected based on similar arguments against the relative approach. Also, surveys indicated that a Government Program Manager would not know the dollar budget to be devoted to Reliability program tasks, for example. Budgets at that level are seldom, if ever, established prior to the issue of a Request for Proposal. Further, the use of absolute values would necessitate additional questions to enable CATSOP to determine if a $900,000 reliability program was lots or little for the program in point.

The "size of the office staff" also gives some indication of budget and emphasis. Sometimes staff size may be known and other times it is not. This approach would also require additional questions to be asked. For example, the staff could be large because they plan to do most of the work in-house and the tailoring for the contractor would be quite severe.

As indicated, the development of the budget question had a great deal of emphasis. While of lesser importance for other questions, the above discussion does demonstrate the considerations and concerns used in structuring all questions/answers.

3.2.3 Explanation Screens All question/answer sets are explained on "Explain" screens, which can be selected if desired. The purpose is to provide insight as to what the system is expecting and/or how the information will be used by R/M/L CATSOP. This information is often used to clarify the distinction between the multiple choices provided. Fig. 1 shows, as an example, the explain screen that goes along with the budget question described above. Explain screens are accessed by typing the entry "explain" at any CATSOP prompt or by pressing F4, the Explain function key. A complete set of "Explain" screens is provided in Appendix C.


CATSOP> explain

BUDGET DESCRIPTION

Descriptor	Definition	Expected Program Results
Normal	Cost analyses indicates that based on past experience the total budget will be adequate to do a nominal risk program.	Procuring agency wants a "full" or "typical" program which meets objectives, has minimal risks, and is cost effective but not constrained due to budget. Tasks are selected based on all other considerations.
Limited	60 - 90 % of a "normal" budget.	Procuring agency wants less than a "full" program. Tasks that are considered less than mandatory to meet objectives are not specified. Reasonable backup, justification and tradeoffs are still required.
Very Limited	Less than 59 % of a "normal" budget.	Procuring agency expects minimal emphasis. Perform only mandatory tasks with little or no trades, backup, or other justification.

Press F5 to continue.

Figure 1. Sample R/M/L CATSOP Explain Screen

3.3 RULE DEVELOPMENT

The tailoring rules contained in R/M/L CATSOP were developed from the expert knowledge captured in the computer expert information data base. This section provides an overview of the rule development process. Section 5.0 contains more descriptive information on each of the rule types identified below.

3.3.1 Development Process The expert information data base was structured to contain one file for each MIL-Standard task or sub-task. Each of the tailoring criteria discussed in the preceding section (Paragraph 3.2.1) and their various possible states were identified as separate fields in each file. Several experts then went through the data base and identified what impact each criteria state would have on the scope and depth of each task. Entries ranged from no impact to that the task would be performed in a limited way or not at all. Sometimes the experts would recognize that a combination of criteria would be necessary to affect the task selection and so note.

The experts were also asked to describe in general terms the information needed to perform the task, its sources, and the information developed by the task (information, not necessarily deliverable data items).

The rules contained in R/M/L CATSOP represent a consensus of the expert knowledge thus captured in the data base. Sorting capabilities of the data base were used to list, combine, and rank the data to facilitate this process. The sorting highlighted points common across tasks and consolidated information by task. The resultant rules can be described in the following eight categories. No need for rules of any other type was identified.

PROGRAM PHASE APPLICABILITY
GENERAL PROGRAMMATIC CONSIDERATIONS
BUDGET CONSIDERATIONS
TASK RANKING
ABSENCE OF OTHER TASKS
PREVIOUS EFFORT ACCOMPLISHED
NOTE APPLICATION
LINKAGE CHECKING

3.3.2 Basic Tailoring Rules The first three categories of rules in the above list eliminate or qualify tasks that are implicitly not required or are to be done in a limited way. These rules are divided into the three separate categories only for descriptive and implementation purposes. These rules are a direct implementation of the expert information in the data base.

3.3.3 Task Ranking Rules Ranking of tasks is a requirement levied by RADC. The major purpose for this requirement is to provide guidance for further tailoring by the user if desired. In other words, R/M/L CATSOP recommends specific tailoring. It also lists the relative importance of the recommended tasks. The user can then consider deleting additional tasks if deemed necessary using the ranking guide. Task ranking values are also used in some of the tailoring rules.

Task ranking was originally asked of the experts as direct questions in the data base. This became very subjective and difficult to answer due to the many possible combinations of tailoring criteria. The final selected approach was to have the experts identify the six criterion that had the greatest impact on ranking determination. Each ranking criterion was then assigned minimum and maximum values which would produce composite values within the specified range of 1 through 9. Values between the minimum and maximum were allocated across the range of possible criterion states.

The experts were also asked to assign a relative overall generic task ranking to each task. This ranking value did not consider the conditions under which the task was to be applied. The overall task ranking value is computed as the product of all of these individual ranking values based on the user-selected criterion states.

3.3.4 Absence of Other Tasks The experts identified a few tasks that were necessary only if other tasks were required. Rules were written for this situation of the form "Don't do Task A unless Task B is recommended".

3.3.5 Previous Effort There are some tasks that once completed do not need to be repeated on the same program. Also, in MIL-Standard 1388, there are some sub-tasks that are specifically identified as updates to other sub-tasks. For these tasks, it is necessary to consider completed efforts and tailor accordingly.

3.3.6 Linkage Checking Another important aspect of R/M/L CATSOP is that it assures that all prerequisite tasks are considered in the tailoring process. In other words, if Task A is required to provide the data for Task B, R/M/L CATSOP will not recommend Task B without Task A. Further, if the user chooses to select Task B but not Task A, he will be warned of the inconsistency.

Rules that establish these linkage relationships were developed from task information requirements established in the expert information data base previously discussed (Paragraph 3.1).

3.3.7 Note Application Note application rules are a special subset of some of the previous categories. These rules determine when and how a task should be qualified or limited in its application.

3.4 RULE IMPLEMENTATION

R/M/L CATSOP utilizes the M.1 commercial expert system shell by Tecknowledge (a discussion on the selection of this shell is contained in paragraph 6.1 of this report). The implementation was performed by Software Engineers experienced in Artificial Intelligence techniques. These engineers performed the knowledge engineering function, which incorporated the R/M/L task information and tailoring heuristics into an easy to use expert system.

3.5 RULE COMPLETENESS

The R/M/L CATSOP knowledge base is complete for all tasks applicable to the Concept Definition phase plus a few other tasks unique to other phases. Table 2 contains a listing of all the tasks in the three MIL-Standards. The columns to the right identify the acquisition phase applicability of each task/sub-task. The unshaded area of Table 2 denotes those tasks for which complete rule sets have been incorporated in R/M/L CATSOP. All other tasks have limitted or no rules and are not considered in the tailoring, i.e., they are never recommended for application.

3.6 RAPID PROTOTYPING

A development technique often used for expert systems is rapid prototyping where a subset of the problem is quickly implemented and, if successful, the system is expanded incrementally. An advantage of this technique is that results can be seen at an early stage and users can provide feedback on the user interface and system design. It also serves as proof of the implementation concepts.

A rapid prototyping approach was taken for CATSOP, although there were some problems along the way. The intent was to mechanize all aspects of tailoring for a few tasks and then expand. The problem was that simple tasks were used for the initial work. The ranking approach taken for these tasks was later found to be inadequate for 1388-1a. This necessitated a new ranking approach to be implemented late in the program.

3.7 DEVELOPMENT OF USER INTERFACE FEATURES

R/M/L CATSOP includes all of the user characteristics expected of computer applications packages. Rockwell Software Engineers designed an R/M/L CATSOP that is user friendly, can be stopped and restarted, allows for simple revision of input data, does error checking, minimizes key strokes, provides for storage and recall of session files, provides for hardcopy printouts, assists with HELP screens, allows user override, and provides an audit trail of all actions taken. These features are described in more detail in section 4.0 of this document.

TABLE 2 Listing of Tasks for Which Rules are Implemented (page 1 of 3)

TASK NUMBER AND DESCRIPTION		APPLICABLE TASKS BY PROGRAM ACQUISITION PHASE				
		PRE-CONCEPT	CONCEPT	DEM-VAL	FSD	PRODUCTION
M101	MAINTAINABILITY PROGRAM PLAN		●	●	●	●
M102	MONITOR/CONTROL OF SUBCONTRACTORS AND VENDORS		●	●	●	●
M103	PROGRAM REVIEWS		●	●	●	●
M104	DATA COLLECTION, ANALYSIS AND CORRECTIVE ACTION SYSTEM			●	●	●
M201	MAINTAINABILITY MODELING		●	●	●	●
M202	MAINTAINABILITY ALLOCATIONS		●	●	●	●
M203	MAINTAINABILITY PREDICTIONS		●	●	●	●
M204	FAILURE MODES AND EFFECTS ANALYSIS, MAINTAINABILITY INFORMATION		●	●	●	●
M205	MAINTAINABILITY ANALYSIS		●	●	●	●
M206	MAINTAINABILITY DESIGN CRITERIA			●	●	●
M207	PREPARATION OF INPUTS TO DETAILED MAINTENANCE PLAN AND LSA			●	●	●
M301	MAINTAINABILITY DEMONSTRATION			●	●	●
R101	RELIABILITY PROGRAM PLAN		●	●	●	●
R102	MONITOR/CONTROL OF SUBCONTRACTORS AND VENDORS		●	●	●	●
R103	PROGRAM REVIEWS		●	●	●	●
R104	FAILURE REPORTING, ANALYSIS AND CORRECTIVE ACTION SYSTEM (FRACAS)			●	●	●
R105	FAILURE REVIEW BOARD			●	●	●
R201	RELIABILITY MODELING		●	●	●	●
R202	RELIABILITY ALLOCATIONS		●	●	●	●
R203	RELIABILITY PREDICTIONS		●	●	●	●
R204	FAILURE MODES, EFFECTS, AND CRITICALITY ANALYSIS (FMECA)		●	●	●	●
R205	SNEAK CIRCUIT ANALYSIS (SCA)				●	●
R206	ELECTRONIC PARTS/CIRCUITS TOLERANCE ANALYSIS				●	●
R207	PARTS PROGRAM		●	●	●	●
R208	RELIABILITY CRITICAL ITEMS		●	●	●	●
R209	EFFECTS OF FUNCTIONAL TESTING, STORAGE, HANDLING, PACKAGING, ETC.			●	●	●
R301	ENVIRONMENTAL STRESS SCREENING			●	●	●
R302	RELIABILITY DEVELOPMENT/GROWTH TESTING			●	●	
R303	RELIABILITY QUALIFICATION TEST (RQT) PROGRAM			●	●	●
R304	PRODUCTION RELIABILITY ACCEPTANCE TEST (PRAT) PROGRAM				●	●

TASKS WITH ONLY PARTIAL RULES IMPLEMENTED IN R/M/L CATSOP

TABLE 2 Listing of Tasks for Which Rules are Implemented (page 2 of 3)

TASK NUMBER AND DESCRIPTION	APPLICABLE TASKS BY PROGRAM ACQUISITION PHASE				
	PRE-CONCEPT	CONCEPT	DEM-VAL	FSD	PRODUCTION
L101 DEVELOPMENT OF AN EARLY LSA STRATEGY		●	●	●	
L102 LOGISTIC SUPPORT ANALYSIS PLAN		●	●	●	●
L103 PROGRAM AND DESIGN REVIEWS		●	●	●	●
L201 USE STUDY	●	●	●	●	
L202 MISSION HARDWARE, SOFTWARE AND SUPPORT SYSTEM STANDARDIZATION		●	●	●	●
L203 COMPARATIVE ANALYSIS					
SUBTASK 203.2.1	●	●	●		
SUBTASK 203.2.2	●	●	●	●	
SUBTASK 203.2.3	●	●	●		
SUBTASK 203.2.4	●	●	●	●	
SUBTASK 203.2.5	●	●	●	●	
SUBTASK 203.2.6	●	●	●		
SUBTASK 203.2.7		●	●	●	
SUBTASK 203.2.8	●	●	●	●	
L204 TECHNOLOGICAL OPPORTUNITIES		●	●	●	
L205 SUPPORTABILITY AND SUPPORTABILITY RELATED DESIGN FACTORS					
SUBTASK 205.2.1		●	●		
SUBTASK 205.2.2		●	●		
SUBTASK 205.2.3		●	●	●	●
SUBTASK 205.2.4		●	●		
SUBTASK 205.2.5			●	●	
L301 FUNCTIONAL REQUIREMENTS DEFINITION					
SUBTASK 301.2.1		●	●	●	●
SUBTASK 301.2.2		●	●	●	●
SUBTASK 301.2.3		●	●	●	●
SUBTASK 301.2.4		●	●	●	●
SUBTASK 301.2.5		●	●	●	●
SUBTASK 301.2.6		●	●	●	●
L302 SUPPORT SYSTEM ALTERNATIVES					
SUBTASK 302.2.1		●	●	●	
SUBTASK 302.2.2		●	●	●	
SUBTASK 302.2.3		●	●	●	●
SUBTASK 302.2.4		●	●	●	●
SUBTASK 302.2.5		●	●	●	●

TASKS WITH ONLY PARTIAL RULES IMPLEMENTED IN R/M/L CATSOP 

NOTE: ALL LSA TASKS ARE DETAILED TO THE SUB-TASK LEVEL IN R/M/L CATSOP. THIS CHART IS SUMMARIZED TO THE TASK LEVEL WHEN ALL SUB-TASKS HAVE THE SAME PHASE APPLICABILITY.

TABLE 2 Listing of Tasks for Which Rules are Implemented (page 3 of 3)

TASK NUMBER AND DESCRIPTION	APPLICABLE TASKS BY PROGRAM ACQUISITION PHASE				
	PRE-CONCEPT	CONCEPT	DEM-VAL	FSD	PRODUCTION
L303 EVALUATION OF ALTERNATIVES AND TRADEOFF ANALYSIS SUBTASK 303.2.1		●	●	●	●
SUBTASK 303.2.2		●	●	●	●
SUBTASK 303.2.3		●	●	●	●
SUBTASK 303.2.4		●	●	●	
SUBTASK 303.2.5		●	●	●	
SUBTASK 303.2.6		●	●	●	●
SUBTASK 303.2.7		●	●	●	●
SUBTASK 303.2.8		●	●	●	
SUBTASK 303.2.9		●	●	●	●
SUBTASK 303.2.10		●	●	●	●
SUBTASK 303.2.11		●	●	●	●
SUBTASK 303.2.12		●	●	●	
L401 TASK ANALYSIS SUBTASK 401.2.1			●	●	●
SUBTASK 401.2.2			●	●	●
SUBTASK 401.2.3			●	●	●
SUBTASK 401.2.4			●	●	●
SUBTASK 401.2.5			●	●	●
SUBTASK 401.2.6			●	●	●
SUBTASK 401.2.7			●	●	●
SUBTASK 401.2.8			●	●	●
SUBTASK 401.2.9			●	●	●
SUBTASK 401.2.10			●	●	●
SUBTASK 401.2.11			●	●	●
L402 EARLY FIELDING ANALYSIS				●	●
L403 POST PRODUCTION SUPPORT ANALYSIS					●
L501 SUPPORTABILITY TEST, EVALUATION, AND VERIFICATION SUBTASK 501.2.1		●	●	●	
SUBTASK 501.2.2			●	●	●
SUBTASK 501.2.3			●	●	●
SUBTASK 501.2.4				●	●
SUBTASK 501.2.5					●

TASKS WITH ONLY PARTIAL RULES IMPLEMENTED IN R/M/L CATSOP

NOTE: ALL LSA TASKS ARE DETAILED TO THE SUB-TASK LEVEL IN R/M/L CATSOP. THIS CHART IS SUMMARIZED TO THE TASK LEVEL WHEN ALL SUB-TASKS HAVE THE SAME PHASE APPLICABILITY.

3.8 DOCUMENTATION

Three software documents were prepared in accordance with DOD-STD-2167 describing the details of the R/M/L CATSOP mechanization. These documents and a summary of their contents are as follows:

Software Top Level Design Document (STLDD) - The STLDD presents the allocation of CATSOP expert system requirements specified in the Statement of Work (SOW) to Top Level Computer Software Components (TLCSCs). Additionally, it describes the input data, local data, output data, and processing characteristics of each TLCSC.

Software Detailed Design Document (SDDD) - The SDDD describes the decomposition of TLCSCs of the CATSOP expert system into Lower Level Computer Software Components (LLCSCs) and Units.

Data Base Design Document (DBDD) - The DBDD describes content and format of each of the 20 knowledge base files. Additionally, it describes the interaction between the files.

4.0 CATSOP CHARACTERISTICS AND CAPABILITIES

The basic R/M/L CATSOP session is one where all three specifications are tailored for a new program. In this basic session, the user provides answers to all questions and R/M/L CATSOP provides the recommended tailoring. In addition to this basic capability, R/M/L CATSOP has many other features which enable numerous variations to this scenario as desired by the user.

Instructions for R/M/L CATSOP operation are generally self-contained within the program. Thus, very little is required by way of external operating information. R/M/L CATSOP is menu driven throughout. Questions are stated with multiple choice answers. When applicable, instructions are given as to the next step. Help information is provided when requested by the user.

The following overview is provided as an introduction to specific R/M/L CATSOP capabilities. This overview will assist the reader and/or user in understanding what to expect in an R/M/L CATSOP consultation. Appendix A to this report contains a complete printout of a sample user tailoring session. Appendix B provides a more comprehensive set of user instructions.

4.1 SESSION USER INTERACTION

R/M/L CATSOP is a menu driven system; that is, the user is presented with a list of selectable responses or options at each step of the consultation. The format of the selectable response is an option number with a description of the action invoked alongside. The user responds by simply entering the number corresponding to the action desired. There are a few exceptions where the system displays a question requiring a yes/no response or a free form response such as a date entry.

The user may also control the consultation by use of the function keys. The F1 CATSOP function key can be used at any time to invoke the on-line HELP feature. The F2 SCROLL function key is used to scroll back in the system output. The F3 CONTINUE key is used when the user is ready to continue on from a paused state. F4 EXPLAIN provides explanations of the current prompt/menu.

4.2 BASIC R/M/L CATSOP OPERATION

Fig. 2 is a representation of the top level R/M/L CATSOP operational flow. The first menu following the initial CATSOP banner is represented on the top of Fig. 2, entitled CATSOP Option Menu. This menu offers the choices indicated. They are explained below (paragraphs 4.2.1 through 4.2.3.)

Following the tailoring process, a User Options Menu appears. Options provided in this menu relate to output and/or revision of the session data. The contents of this menu are shown on the bottom of Fig. 2 and are also discussed in the following paragraphs.

4.2.1 Tailor a New Program This is the basic capability. This option is selected when the user is not continuing from previously entered data. Selecting this option moves the user through the complete series of applicable questions, which define a new program to R/M/L CATSOP for tailoring. Following the entry of all answers, the tailoring is performed by R/M/L CATSOP.

A choice for each of the questions is the answer of "unknown". If the answer "unknown" is given for a question, all rules based on that question are ignored. A message is included in the tailoring output which says that the tailoring was performed with answers of "unknown" for the following questions. Following the tailoring, the bottom menu of Fig. 2 appears offering the same options as either of the other two type sessions.

4.2.2 Revise a Previous Program If the user has completed and stored the results from a previous session, he may return to that session. In so doing, he may modify one or more of the answers given in the previous session and ask for a revised tailoring output. He may also exercise any or all of the other options shown in the User Options Menu at the bottom of Fig. 2.

4.2.3 Resume a Previous Program If it is necessary to interrupt a session prior to the tailoring, the data entered up to that time can be saved. Upon returning, the user selects Option 3 from the CATSOP Option Menu shown at the top of Fig. 2. The name of the saved file is requested and the contents are loaded. R/M/L CATSOP resumes at the exact point at which it was interrupted. Again, after the initial tailoring, he may also exercise any or all of the other options shown in the User Options Menu at the bottom of Fig. 2.

4.2.4 Display Results This selection is to output the recommended tailoring. This output lists each task that is to be accomplished, the relative importance ranking assigned to the task, and any qualifying notes further describing the task details. Fig. 3 is an excerpt from a typical output report.

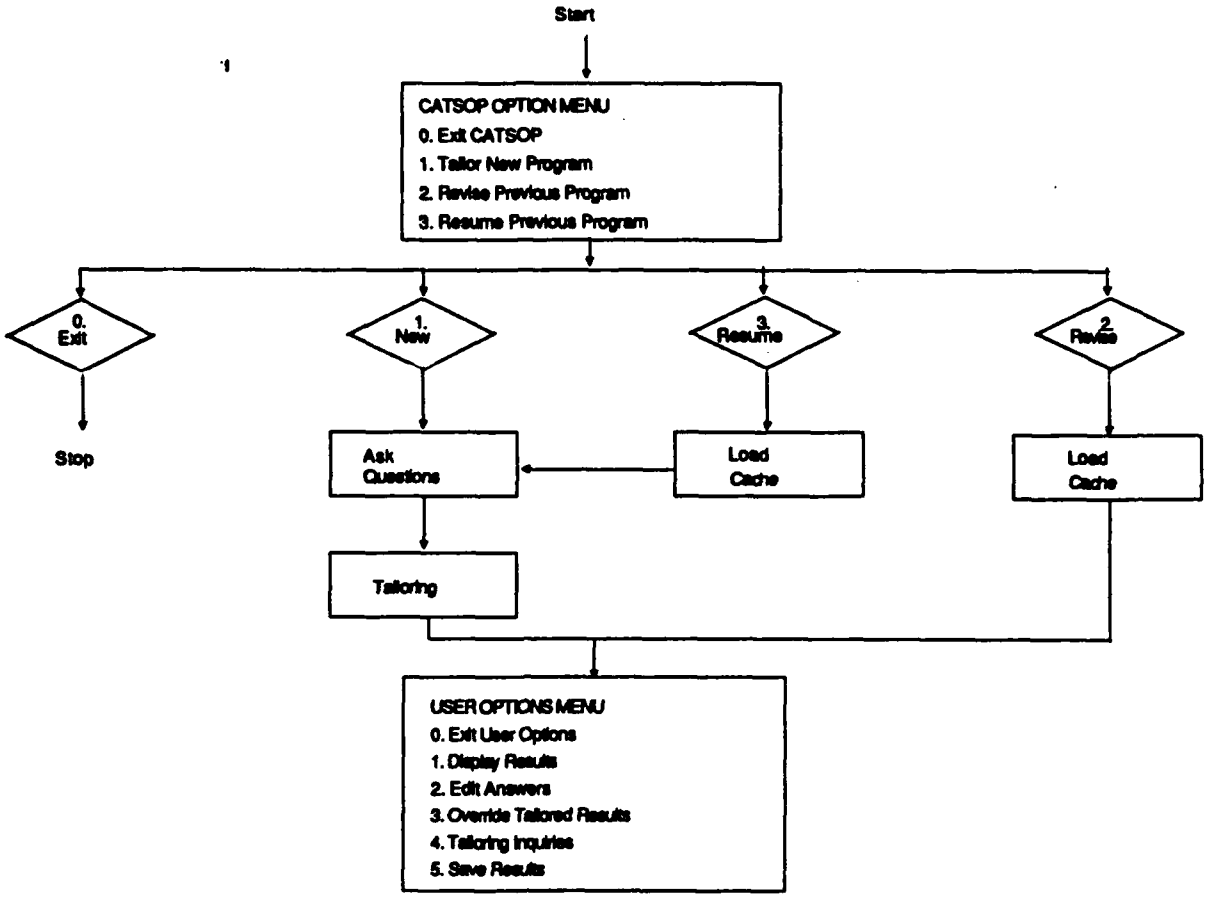


Figure 2. Basic R/M/L CATSOP Operational Flow

Program Name: Attack Radar
Program Phase: Concept Exploration
Solicitation Number: 1234
Consultation Date: 8/1/89

CATSOP Tailoring Recommendation

MIL-STD-1388-1A

Task 102.2.1 - Logistic Support Analysis Strategy Plan
Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)

Task 301.2.1 - Functional Requirements
Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)

Qualifiers:

Identify and Document Functions only to the support levels consistent with the design and trade activities of this phase.

Task 301.2.3 - Risks
Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)

Qualifiers:

Maximize effectiveness and limit effort expended in risk analysis and/or alternative evaluation by considering only the most influential factors and characteristics.

Figure 3. Excerpt from R/M/L CATSOP Tailoring Recommendation Report

4.2.5 Edit Answers If one or more previous answers are to be changed, this option is selected. A menu is presented from which the user can select which question is to be re-answered. When a question is selected, R/M/L CATSOP returns with the current answer to that question. Also, the multiple choice list of possible answers is listed from which to select the new answer.

4.2.6 Override Tailored Results This User Option allows the user to add or delete tasks from the recommended list. Deletions may be as recommended by R/M/L CATSOP based on ranking. Under this option, the least valued tasks (according to the ranking rules) are identified and the user can select those desired for elimination.

Changes may also be made by the user based on information or desires he may have independent of R/M/L CATSOP. In either approach, if the user requests a task deletion R/M/L CATSOP will describe the impact of that decision. The user is then given the option to continue with the deletion or decline.

Task linkages are also checked when an override is invoked. The user is warned if the override impacts or requires another task.

4.2.7 Tailoring Inquiries The user can inquire about the decisions made by the system. He can ask why a specific task is required or why it was eliminated. He can also ask what determined the qualifiers and the cost effectiveness ranking. The system will respond by identifying the rules that supported the system's decision.

4.2.8 Save Results At any point, the user can elect to save the work completed to a storage file. This option asks for the name of the file that is to be used and performs the save function.

4.3 OTHER R/M/L CATSOP CHARACTERISTICS

There are several additional R/M/L CATSOP features and capabilities that are summarized in the following paragraphs.

4.3.1 Tailoring of One or Two Standards Tailoring of all three standards in one session is the desired approach. However, any combination of the three can be tailored in a given session. In any case, linkages (see paragraph 5.9 and Appendix E) between tasks of all three Standards are always checked. The user is notified of tasks in the standard(s) not tailored that must also be done to complete the tasks in the tailored standard.

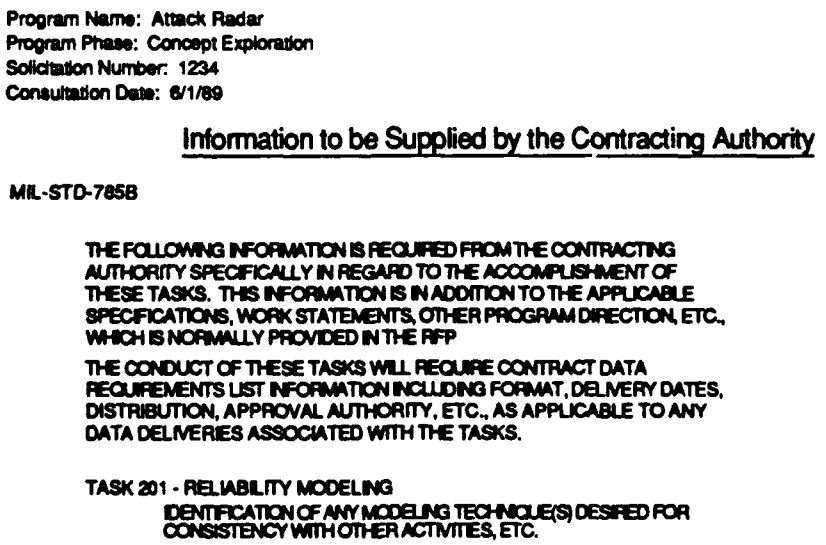
4.3.2 Changing Previous Answers Previously provided answers to the tailoring questions can be modified and the system will re-tailor as necessary.

4.3.3 Volunteering Information The simplest method of entering data into R/M/L CATSOP is to answer the questions as they are asked. However, a capability is provided to designate the answers without having R/M/L CATSOP ask the question. This is accomplished by coding the value of terms representing the answer to each question. Help is provided in defining each term and the format for this coding process.

4.3.4 HELP Screens Two types of user help are provided. Pressing the "Explain" key while answering any user question will display definitions and explanations to help the user understand and answer the question. The "CATSOP" Key provides help in performing functions and understanding options. Both keys are defined in the legends.

4.3.5 Audit Trail An Audit trail can be maintained that identifies the rules that fired and any override actions that were performed during a tailoring session. The audit trail is a valuable tool for test and debugging of knowledge base changes. It also allows the user to see how his responses influence the system output. This audit trail can be printed on hardcopy form. It is automatically saved at the end of a consultation. Appendix A contains a sample audit trail and additional explanations.

4.3.6 Information to be Supplied by Contracting Authority A report may be selected by the R/M/L CATSOP user that describes the unique information needed by the contractor to do each recommended task. The information requirements listed in this report are in addition to the normal program information found in the Program Specifications and Statement of Work. It is limited to information provided by the Contracting Authority. Fig. 4 is an excerpt from a sample report.



Program Name: Attack Radar
Program Phase: Concept Exploration
Solicitation Number: 1234
Consultation Date: 6/1/89

Information to be Supplied by the Contracting Authority

MIL-STD-785B

THE FOLLOWING INFORMATION IS REQUIRED FROM THE CONTRACTING AUTHORITY SPECIFICALLY IN REGARD TO THE ACCOMPLISHMENT OF THESE TASKS. THIS INFORMATION IS IN ADDITION TO THE APPLICABLE SPECIFICATIONS, WORK STATEMENTS, OTHER PROGRAM DIRECTION, ETC., WHICH IS NORMALLY PROVIDED IN THE RFP

THE CONDUCT OF THESE TASKS WILL REQUIRE CONTRACT DATA REQUIREMENTS LIST INFORMATION INCLUDING FORMAT, DELIVERY DATES, DISTRIBUTION, APPROVAL AUTHORITY, ETC., AS APPLICABLE TO ANY DATA DELIVERIES ASSOCIATED WITH THE TASKS.

TASK 201 - RELIABILITY MODELING

IDENTIFICATION OF ANY MODELING TECHNIQUE(S) DESIRED FOR CONSISTENCY WITH OTHER ACTIVITIES, ETC.

Figure 4. Excerpt from Information to be Supplied by Contracting Authority report.

5.0 CATSOP TAILORING RULES

R/M/L CATSOP recommended MIL-Standard tasks, qualifying notes, and ranking values are determined by a set of rules. These rules constitute the tailoring intelligence of R/M/L CATSOP. They were developed based on information gathered from the community of "Experts". This section describes these rules and their application. A complete listing of all rules included in R/M/L CATSOP is included in Appendix D to this report. The methodology that determined the rule content is described in the development program overview, Section 3.0.

5.1 RULE APPLICATION FLOW

The tailoring (or rule application) flow within R/M/L CATSOP is depicted in Fig. 5. This flow is performed separately for each of the three MIL-Standards. R/M/L CATSOP starts with the complete list of tasks for each of the three MIL-Standards. Tasks are deleted and/or assigned qualifying notes as applicable until the final list of recommended tasks is reached. Phase and Programmatic rules are the first to be applied. Ranking factors are computed for the remaining tasks. This is necessary before budget rules can be applied. Ranking computation is necessary at this point since budget rules include ranking values. Final tailoring considers the previous effort accomplished and assigns the qualifying notes as applicable.

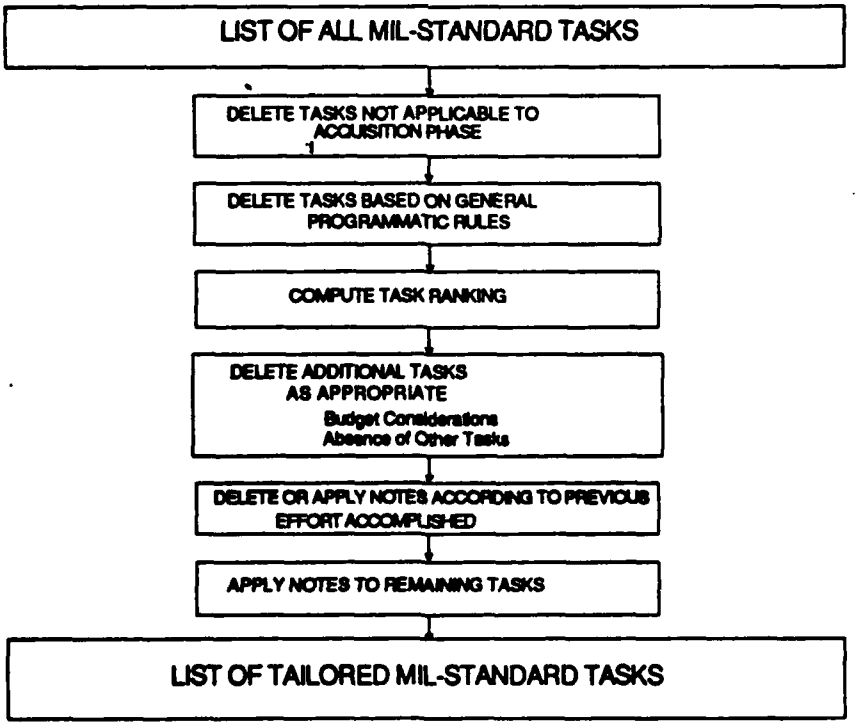


Figure 5. R/M/L CATSOP Generalized Tailoring Flow

5.2 PHASE TAILORING RULES

The experts used in the R/M/L CATSOP development were generally in agreement with the program phase applicability tables in the MIL-Standards. Exceptions are Maintainability Tasks 101 (Maintainability Program Plan), 102 (Control of Vendors), 203 (Maintainability Predictions), and 204 (FMEA Maintainability Information). The experts considered these tasks to be selectively applicable in the concept phase even though MIL-STD-470 lists them as not applicable. Emphasis on maintainability features early in conceptual definition is often appropriate since design and diagnostic approaches may be determined in this time frame. This is consistent with the applicability of the equivalent Reliability tasks.

Also, current emphasis on improved diagnostics places earlier importance on some tasks than implied in the Standard. For example MIL-Standard 785 lists the FMECA as selectively applicable in the earlier phases. R/M/L CATSOP does not contradict that but does place significant emphasis on that effort early in the program.

Phase tailoring rules are an integral part of the "Task Deletion and Note Application Rules" provided in Appendix D.

5.3 GENERAL PROGRAMMATIC RULES

General Programmatic Rules cover the majority of the input question conditions. These rules vary in content as necessary to cover the varying conditions described by the answers given to the input questions. Major subjects covered by these rules are the hardware level, maintenance concept, amount of new design, application, criticalness, and specification development. One example is as follows:

> If the contract item requires a simple modification in an existing environment and the reliability program does not require a significant emphasis, don't do MIL-STD-785 task 207.2.2, Reliability Design Guidelines.

5.4 TASK RANKING RULES

Task Ranking (or effectiveness) is used in R/M/L CATSOP for tailoring in conjunction with budget levels. Ranking values are used to identify possible tasks for deletion beyond those recommended by R/M/L CATSOP. Ranking is also provided to the user in the tailored list of recommended tasks. Task Ranking is a numeric value with a range from one to nine. One represents the most importance or effectiveness under the conditions defined for the session.

The ranking value is computed for each task based on six input descriptors. The computation is a product of three factors: A, B, and C. The values of the three factors are determined from two input descriptors for each factor. Table 3 provides a summary of the inputs used for each factor. Full details of the rules and computation values are contained in the "Task Importance Ranking Rules" , Section III, Appendix D.

Factor A in the ranking calculation is the Hardware Design and Application factor. Its value is determined by the hardware design maturity and for MIL-STD-1388 tasks the hardware application. For the R and M tasks, the schedule is the second determinant.

Table 4 is a matrix showing how factor A is determined for the LSA tasks from the hardware maturity and application. The combination of existing assemblies in an existing application is the condition of least importance (highest numeric value). On the other extreme, for the condition of a new design, advanced state of the art, is of the greatest importance regardless of application.

Factor B is the Hardware Utilization factor. The value of factor B is determined by the type of hardware being procured, e.g., Airborne, Manpack, etc. The value of factor B is also determined from the expected fielded quantity for LSA tasks and the hardware criticalness for the R & M tasks.

TABLE 3 Task Ranking Factor (TRF) Computation

TASK RANKING FACTOR = A x B x C

ROUNDED UP TO NEAREST INTEGER

1 – MOST IMPORTANT

9 – LEAST IMPORTANT

WHERE:		IS A FUNCTION OF:	
		MIL-STD-1388	MIL-STD-785 AND 470
A =	HARDWARE DESIGN AND APPLICATION FACTOR	HARDWARE MATURITY HARDWARE APPLICATION	HARDWARE MATURITY SCHEDULE
B =	HARDWARE UTILIZATION FACTOR	HARDWARE UTILIZATION EXPECTED FIELDED QTY	HARDWARE UTILIZATION HARDWARE CRITICALITY
C =	TASK IMPORTANCE FACTOR	LSA TASK LSA OBJECTIVE	R/M TASK DESIGN CHALLENGE

TABLE 4 Sample Ranking Factor Matrix (Factor A)

		07A EXISTING APPLICATION	07B MODIFIED APPLICATION	07C NEW APPLICATION
06A	EXISTING MAJOR ASSEMBLIES	20.0	19.0	18.0
06B	SIMPLE MOD	19.0	18.0	18.0
06C	MAJOR MOD	18.0	19.0	17.0
06D	NEW DESIGN - EXISTING STATE OF ART	17.0	17.0	16/0
06E	NEW DESIGN - NEW MATERIALS/PROCESSES	16.0	16.0	16.0
06F	NEW DESIGN - ADVANCED STATE OF ART	15.0	15.0	15.0

Task Importance is considered in Factor C. This factor value is determined based on a raw ranking assigned to each task, adjusted by the input design challenge or LSA objective.

The numerics used to compute the values of each of the three factors (A, B, and C) are specified in R/M/L CATSOP in a matrix form. Table 4 shows the numerics for Factor A as explained earlier. Numerics for Factors B and C are structured in a similar manner. Individual factor value ranges are such that the product of the three factors yields an integer within the range of 1 to 9.

Table 5 shows two sample calculations for the overall Task Ranking Factor. As stated previously, the Task Ranking Factor is the product of the three input factors, rounded up to the next highest integer. Table 5 shows selected values of each input factor based on some assumed conditions as noted. The product of the three input factors yields the overall Task Ranking Factor as shown. As the R/M/L CATSOP questions are answered differently by the user, the input factors take different values and the Task Ranking Factor value changes accordingly.

TABLE 5 Sample Task Ranking Factor Computations

A	B	C	TRF
EXIST ASSEMB EXISTING APP 20.0	MANPACK < 500 0.045	201 USE STUDY NO LSA CONSID. 9.0	9.0
NEW DESIGN AD NEW APP 15.0	AIRBORN > 100 0.020	204 TECH OPPOR. MAKE-UP 3.0	1.0

5.5 BUDGET CONSIDERATION RULES

Budget limitations cause the elimination of the lower-ranked tasks. If the budget is limited, tasks with a ranking value of 8 or 9 are not recommended. If the budget is very limited, tasks with rankings of 6 through 9 are eliminated. These threshold values were selected somewhat arbitrarily. However, they represent the tailoring concept that the least important tasks are not recommended if budget is limited. Further, the results have been reviewed by the experts with their concurrence as a general model.

In addition, if the budget is very limited, LSA tasks related to alternatives and risk analysis are eliminated. The reasoning for this is that alternative and risk evaluation are "frosting" so to speak. A solution will be determined without the alternative and risk evaluation tasks, albeit perhaps not the most cost effective solution. A very limited budget translates to minimal emphasis, which means little or no backup or other justification.

5.6 RULES RELATING TO THE ABSENCE OF OTHER TASKS

The existence of several tasks can be determined by the absence or existence of other tasks. Two examples of rules of this type are as follows:

> If there are three or less separate other Reliability or Maintainability tasks, don't do the corresponding Program Plan (Task 101).
>
> Do not do the LSA Risk Analysis Tasks unless the corresponding Study Tasks are selected.

5.7 PREVIOUS EFFORT RULES

Efforts already accomplished can impact the task tailoring. Questions 17 through 20 ask the user about the previous efforts accomplished. Alternate answers are "completed", "partially completed", or "none". "Completed" is interpreted literally, i.e., there is no need for any further update of the product of that task. All information or objectives of that task have been completed and are available for related efforts.

Some tasks are never considered to be complete and they are not considered in this category of rules. Program Plans and Supplier Control tasks are examples.

Update LSA tasks are invoked instead of the basic tasks if the basic task is identified as having been partially completed.

5.8 RULES FOR QUALIFYING NOTE APPLICATION

Qualifying notes define the extent to which the task is to be accomplished. Notes are assigned to tasks that are applicable to the defined program yet require limitations or descriptions in addition to the words of the MIL-Standard. Rules determine which notes to apply based on the answers given in the tailoring consultation. An example of a qualifying note and the rule to invoke it is as follows.

> If the acquisition phase is Concept Exploration or Demonstration/Validation, attach note 4 to task R204.
> Note 4 is: "Perform FMECA at a functional level to support diagnostics development as early as practical. The initial FMECA work may pertain to major functions only. Continue to expand the FMECA as detailed functions are defined".

5.9 TASK LINKAGE RULES

Task linkages are relationships whereby the product of one task is required to complete another. The data base constructed as the repository of the expert knowledge included the definition of information needed for each task and its source. Information links between tasks were thus defined and sorts on the data considered these links. The basic R/M/L CATSOP rules are structured such that linked tasks all have similar rules, i.e., linked tasks will not be eliminated unless they all are not required. A list of all R/M/L CATSOP Linkage Rules is provided in Appendix E.

If the R/M/L CATSOP user decides to add or delete a task, however, he needs to be warned about the impact of that decision on other tasks. R/M/L CATSOP contains linkage rules for each task. When a task is added or deleted, these rules are fired and any impact is noted to the user.

Linkages (information flows) exist between tasks both within and between the three MIL-Standards. Fig. 6 depicts the inter-standard linkages, i.e., information relationships between the three standards. Lines shown between tasks in Fig. 6 represent information flows in the direction of the arrows. A task block shown with an arrow entering means that that task requires the information described in order for it to be performed. The task that is the normal source of that information is shown on the opposite end of the arrow. Labels denoted with dashed lines are included, which indicate the type of information required. It should be noted that these are general identifiers of information type and do not necessarily relate to formal data submittals or reports.

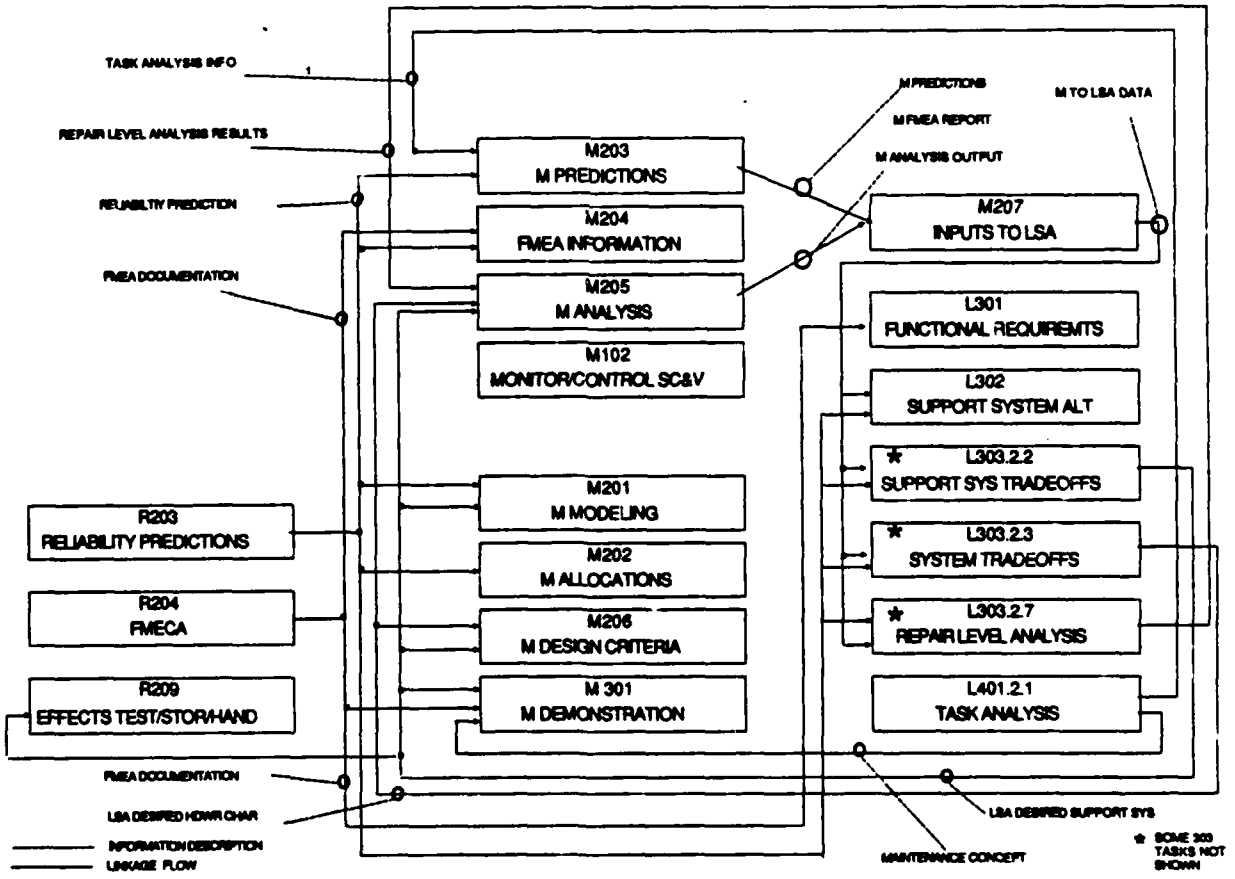


Figure 6. Inter-Standard Task Linkages

6.0 MECHANIZATION DETAILS

R/M/L CATSOP has been mechanized using the M.1 expert system shell. The inherent features of this shell have been maintained. The specific characteristics which are important to R/M/L CATSOP are described in this section.

6.1 SHELL SELECTION

M.1 is a commercially available knowledge system software tool that provides an inference engine and customizable user interface. The M.1 shell selection was based on a tool comparison survey that was performed in 1986, prior to Rockwell's response to the R/M/L CATSOP RFP. The results of that comparison are summarized in Table 6.

Several features contributed to the decision to select the M.1 shell. The user interface is easily adaptable to a menu driven consultation. Questions are added easily and user response is automatically checked by the system. The customizable function keys and pull-down menu are easily adaptable to most any application. The knowledge representation of rules and facts with the use of variables provides powerful pattern matching capabilities. Lastly, the training and documentation is quite extensive.

6.2 M.1 MEMORY LIMITATIONS

When using M.1 on a 640K microcomputer, the run-time memory available is approximately 342,500 bytes. This memory is used for both the knowledge base and the cache. The cache is the repository for all derived conclusions. This equates to approximately 2500 rules and facts depending on their complexity. This limitation is circumvented by partitioning the knowledge base into separate files, which can be overlaid so that only the necessary rules are loaded at any given time. Memory can also be saved by minimizing cache entries. R/M/L CATSOP uses both of these techniques to manage the run-time memory.

6.3 R/M/L CATSOP SOFTWARE COMPONENTS

The R/M/L CATSOP control flow is illustrated in Fig. 7. The Executive module controls the consultation. It will first ask the tailoring questions and then invoke the Tailoring module. The Override module allows the user to add and delete tasks to/from the tailored recommendation. The Audit module provides an audit trail of all tailoring actions and allows the user to make tailoring inquiries about particular tasks. The Help module provides menu driven instructions regarding various R/M/L CATSOP features.

TABLE 6 Expert System Tool Comparison (page 1 of 2)

	M.1	NEXPERT-OBJECT	NEXPERT	PERSONAL CONSULTANT
VENDOR	TECKNOWLEDGE	NEURON, DATA	NEURON, DATA	TEXAS INSTRUMENTS
PROCESSOR	• IBM PC, XT, AT • VAX	• IBM PC/AT	• MACINTOSH	• T.I. PROFESSIONAL COMPUTER
LANGUAGE	C	C	PASCAL	LISP
KNOWLEDGE REPRESENTATION	• FACTS (LIST OR TABLE) • PRODUCTION RULES • RULE CLASSES	• OBJECTS (FRAMES) • PRODUCTION RULES • RULE CLASSES	• CONTEXTS (TREE STRUCTURE) • PRODUCTION RULES	• PRODUCTION RULES • FRAMES
META-KNOWLEDGE REPRESENTATIONS	• META-FACTS — PRESUPPOSITION — EXPLANATION — WHEN FOUND — LEGAL VALUES — AUTO MENUING • META-PROPOSITION — UNKNOWN — KNOWN — UNIQUE — SOUGHT	• META-SLOTS — INHERITANCE • MULTIPLE • NEXPERT OR USER DEFINED • SALIENCE • SOURCE OF INFORMATION		• CLASS INHERITANCE
RULE STRUCTURE	• IF->THEN — EXTENSIVE — VARIABLES — FUNCTIONS — USER DEFINED SYNTAX FOR READABILITY	• IF->THEN->DO — VARIABLES — FUNCTIONS	• IF->THEN->DO — VARIABLES — FUNCTIONS	• IF->THEN — VARIABLES
BASIC REASONING	• PRIMARILY BACKWARD, LIMITED FORWARD	• FORWARD OR BACKWARD (USING SAME RULES)	• FORWARD OR BACKWARD (USING SAME RULES)	• BACKWARD CHAINING
REASONING DETAILS	• DEPTH FIRST SEARCH • INITIAL-DATA • WHEN-FOUND • RULE ORDER • BACKTRACKING	• REASONING ON CLASS • IS THERE AT LEAST... • ARE ALL... • FOCUS OF ATTENTION • NON-MONOTOMIC — TRUTH MAINTENANCE	• FOCUS OF ATTENTION • NON-MONOTOMIC — TRUTH MAINTENANCE	• META-RULES
CERTAINTY REPRESENTATION	• MYCIN-LIKE CERTAINTY FACTORS	• USER DEFINED (META-RULES)	• USER DEFINED	• CERTAINTY FACTORS MYCIN
CONFLICT RESOLUTION	• RULES WITH HIGHEST CERTAINTY FACTOR	• USER DEFINED	• USER DEFINED	

TABLE 6 Expert System Tool Comparison (page 2 of 2)

	M.1	NEXPERT-OBJECT	NEXPERT	PERSONAL CONSULTANT
EXPLANATION	• TEXT-USER CAN DEFINE EXPLANATION SYNTAX BY ATTACHING TEXT TO THE RULES • HOW, WHY, TRACE	• GRAPHICS AND TEXT • HOW, WHY, TRACE	• GRAPHICS AND TEXT • HOW, WHY, TRACE	• GRAPHIC AND TEXT • HOW, WHY, TRACE
ACCESS TO EXTERNAL ROUTINES	• THRU C INTERFACE TO OTHER LANGUAGES	• C, PASCAL, ASSEMBLY FORTRAN		MS.DOS CALLS
KNOWLEDGE ENGINEERING TOOLS	• MUST USE A STANDARD TEXT EDITOR • PANEL MODE • TRACE	• SPECIAL EDITORS — PROJECTS, CLASSES PROPERTY EDITORS • GRAPHICS, HIERARCHY CLASSES • KNOWLEDGE BASE BROWSING — INFERENCE NETWORKS • INCREMENTAL RULE COMPILER — VERIFICATION & MAINTENANCE • MULTIPLE WINDOWS	• SPECIAL EDITORS • FORMAT CHECKING • TYPE CHECKING — MULTIPLE WINDOWS — GRAPHICS — MULTIPLE WINDOWS	• RULE EDITOR AND PROMPTS • MULTIPLE WINDOWS

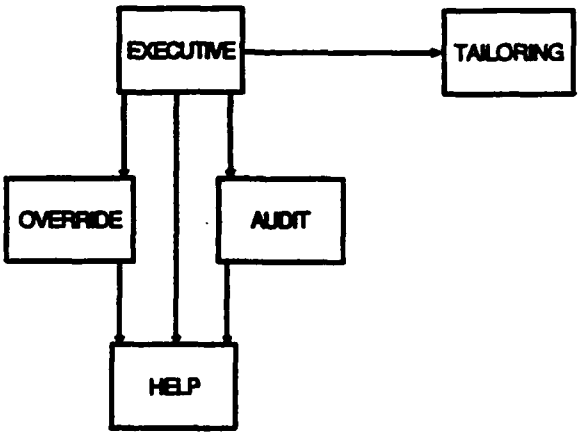


Figure 7. R/M/L CATSOP Control Flow

The R/M/L CATSOP data flow is illustrated in Fig. 8. The Executive controls the questioning and passes along the answers, which are used to perform the tailoring. The Tailoring module generates the tailored tasks along with task rankings and qualifiers. The Override module modifies the tailored tasks. It assigns a default rank to all tasks that are added. All actions are noted on the audit trail.

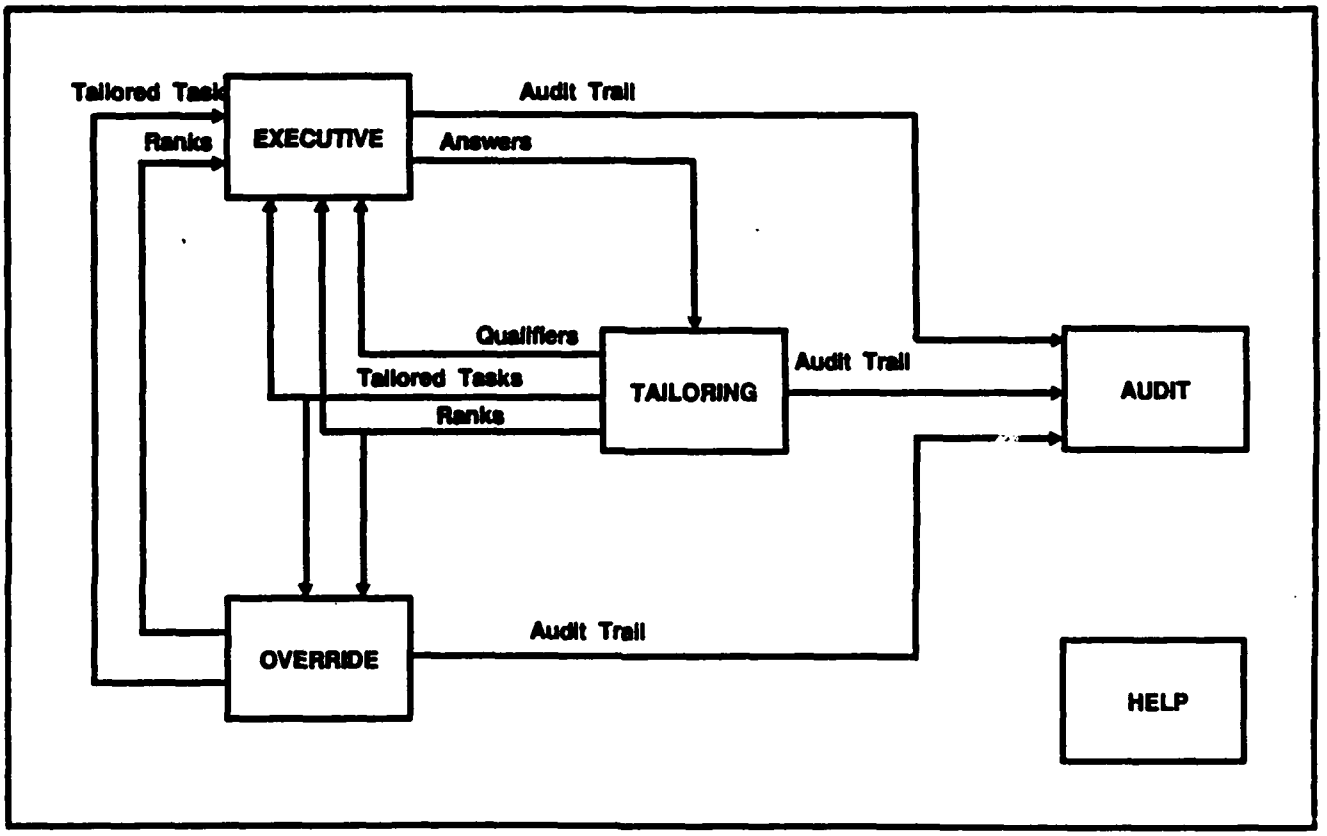


Figure 8. R/M/L CATSOP Data Flow

6.4 KNOWLEDGE BASE PARTITIONING

There are 20 knowledge base partitions (files). Fig. 9 illustrates which files are used by each of the different software components (note that some partitions are used more than once). The knowledge base files along with the R/M/L CATSOP configuration files are inputs to M.1. A detailed list of each knowledge base file and its contents is provided in Table 7.

The configuration file identifies the user interface characteristics such as function keys, screen colors, banner message, and pull-down menu items.

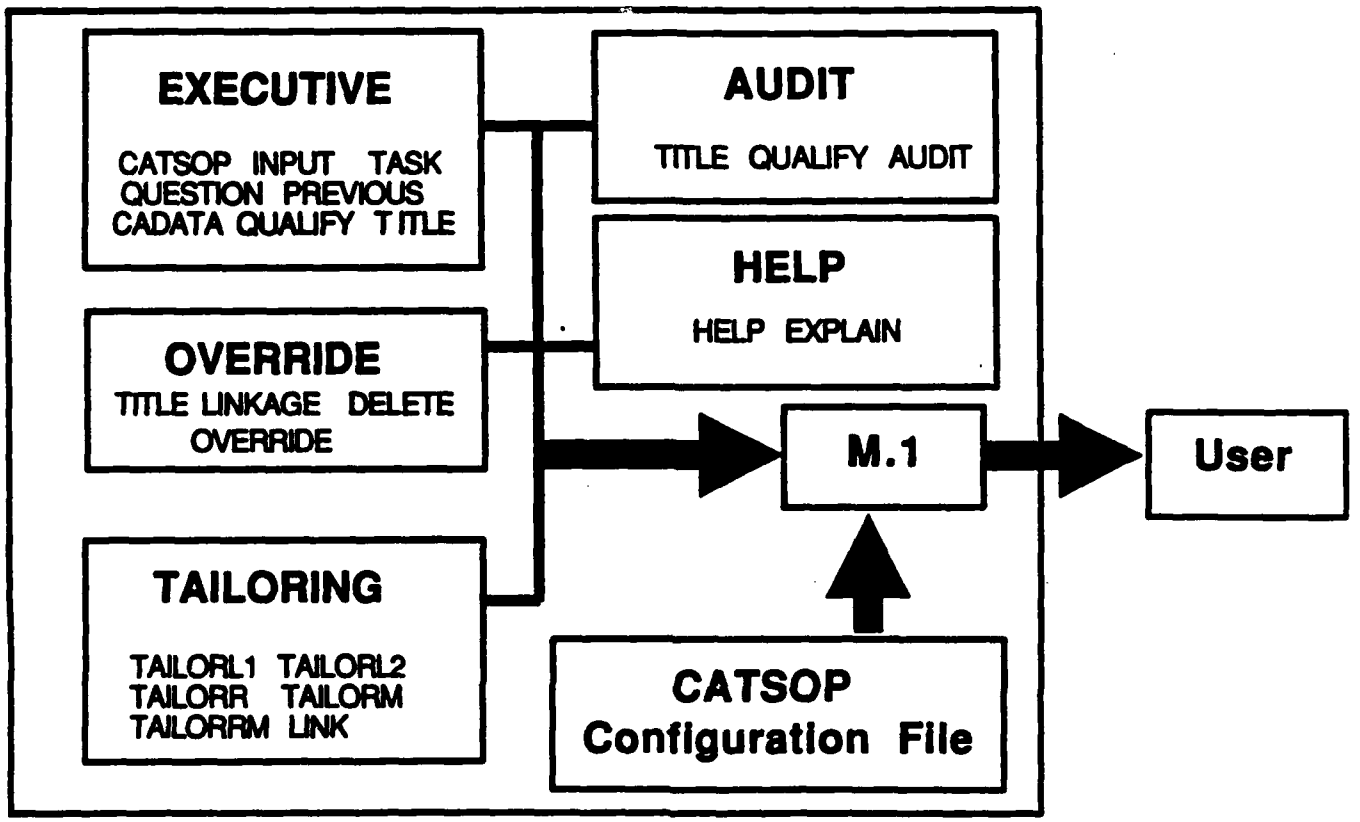


Figure 9. R/M/L CATSOP Knowledge Base Partitions

Table 7 R/M/L CATSOP Knowledge Base Files (Page 1 of 2)

KB File	Description
catsop.kb	This file contains the rules that guide the consultation flow using control menus.
input.kb	This file contains the rules relative to processing all user responses at a very low level. It checks the response for function key interrupts and invokes those knowledge bases that are appropriate.
task.kb	This file identifies each task in each of the R/M/L MIL-Standards.
question.kb	This file contains the tailoring questions that solicit information regarding the acquisition program that is to be tailored.
previous.kb	This file identifies groups of tasks for which the previous effort might be relevant to the tailored result.
cadata.kb	This file identifies the data to be supplied by the contracting authority relative to the R/M/L MIL-Standard tasks.
qualify.kb	This file contains the text that qualifies the scope and effort of various tasks.
title.kb	This file contains the titles of each of the R/M/L MIL-Standard tasks.
linkage.kb	This file contains all task linkages, i.e, tasks that are required as inputs to perform each task.
delete.kb	This file contains the text describing the impact of deleting each of the R/M/L MIL-Standard tasks.
override.kb	This file contains the rules that control the user override feature.

Table 7 R/M/L CATSOP Knowledge Base Files (Page 2 of 2)

KB File	Description
tailorl1.kb	This file contains the elimination and qualifier rules for MIL-Standard 1388-1A.
tailorl2.kb	This file contains the hardware application factor, hardware utilization factor, phase, task importance factor, and update rules for MIL-Standard 1388-1A.
tailorr.kb	This file contains the elimination, phase, qualifier, and task importance factor rules for MIL-Standard 785B.
tailorm.kb	This file contains the elimination, phase, qualifier, and task importance factor rules for MIL-Standard 470A.
tailorrm.kb	This file contains the hardware application factor and hardware utilization factor rules for MIL-Standards 785B and 470A.
link.kb	This file contains only the inter-standard task linkages.
audit.kb	This file contains the rules that generate the audit trail and process the tailoring inquiry feature.
help.kb	This file contains the rules that control the on-line help.
explain.kb	This file contains the explanation text for each menu/question presented to the user.

6.5 KNOWLEDGE BASE UPDATES

The knowledge base files are created and modified using any standard ASCII text editor. The source files are checked for syntax errors as they are loaded into M.1. If errors are identified, they should then be corrected with the editor at this time. Once loaded, the rules can be tested using various M.1 utilities such as trace. Once the knowledge base has been tested, a fast-load file is generated. The fast-load file is a binary file that loads much quicker because there is no syntax checking. For more details on knowledge base updates, see Appendix B, the R/M/L CATSOP User's Guide.

7.0 CONCLUSIONS

The product of R/M/L CATSOP represents the experience and consensus of many experts. Programs defined by R/M/L CATSOP have no conflicting requirements nor do they include nonproductive tasks. Specification tailoring using R/M/L CATSOP saves money. Savings come by performing the tailoring in only a few man-hours. More importantly, each program thus defined will produce hardware that meets its Reliability and Maintainability specifications and has an optimum support system if implemented as specified. This achievement will have been accomplished in the most cost effective manner.

8.0 RECOMMENDATIONS

R/M/L CATSOP has demonstrated the applicability and effectiveness of the AI concept to Specification Tailoring. R/M/L CATSOP as it currently exists is a working tool. However, it is not complete. Several additional features have been identified to further enhance its benefits. It is recommended that the following tasks be accomplished to more fully realize the full CATSOP potential:

1. Complete the R/M/L CATSOP knowledge base by adding rules for all R/M/L MIL-Standard tasks. Tasks not completed are described in Table 2.

2. Conduct a coordinated evaluation of R/M/L CATSOP by Defense and Industry personnel. Incorporate the resulting comments.

3. Add schedule qualifiers to relate the conduct of the tasks to major program events.

4. Identify CDRL Deliverables in the R/M/L CATSOP output.

5. Add the capability to define alternate means of performing the required tasks.

6. Incorporate MIL-STD-2165 (Testability) into the tailoring capability.

APPENDIX A

SAMPLE USER TAILORING SESSION

APPENDIX A

SAMPLE USER TAILORING SESSION

This appendix contains a sample R/M/L CATSOP user tailoring session and the associated Audit Trail. Prior to and accompaning each of these is a narative description of the contents thereof as follows.

I. Narrative Description of the Sample User Session

This section provides a discussion of the various R/M/L CATSOP features demonstrated in the sample session listed in the following section of this appendix. The reader is encouraged to follow along through the sample session log as the features are discussed. For clarity, each feature discussed in this section has an assigned number which corresponds to the annotation in the right margin of the log of a sample session.

1.) Starting a Session

To start a CATSOP session the user moves to the CATSOP directory and then runs the CATSOP batch file as follows:

```
>cd \catsop
>catsop
```

This will invoke M1 and the CATSOP banner will appear while the CATSOP knowledge base is being loaded. The CATSOP Option Menu will appear where the user chooses number 1 to tailor a new program. At this time some preliminary questions are asked which are today's date, the program name, and the solicitation number.

2.) Tailoring Questions

The following series of questions are intended to solicit the information needed during tailoring. Most of the questions are presented in a multiple choice menu format where the user enters the number corresponding to the answer(s) that best fits the procurement program being tailored. Some of the questions solicit a yes/no response and others solicit quantitive/numeric responses.

3.) Explanations

Explanation screens are available for each and every input requested of the user. The explanation is accessed via the F4 EXPLAIN function key, or by typing the key word "explain" at any catsop prompt. The sample session listing illustrates the explanation for the tailoring question regarding the contract support objective. Upon reviewing the explanation the user presses the F5 CONTINUE function key and the consultation resumes.

4.) Help

The user can get help regarding the use of CATSOP via the F1 CATSOP function key or by typing the key word "catsop" at any prompt. The help capability is menu driven and provides help regarding all CATSOP features. The help for interrupts/function keys, editing answers, and volunteering data is illustrated in the sample session. The help feature also provides the user with the knowledge base terminology. This terminology must be used when volunteering information to CATSOP and is also used in the audit trail and tailoring inquiry features. The help lists each knowledge base term and then shows the user the legal values that can be associated with that term. It will then display the text which is normally presented during questioning. The user continues by responding with 0 to exit CATSOP help.

5.) Volunteering Data

The next feature illustrated in the sample session log is volunteering data. This feature allows the user the opportunity to provide inputs out of order if he wishes to do so. The syntax was described in the help that was previously displayed. In the sample log the user volunteers that the schedule constraint is short. Since this information has been volunteered the system will not prompt for the schedule constraint as it normally would.

6.) Answering Unknown

Continuing on with the consultation the next feature illustrated is the ability for the user to respond with "u" which indicates "unknown". From an enumerated menu the user may type 0 which is also interpreted as "unknown". The implications of this, as far as tailoring, are that the missing information may prevent certain tasks from being eliminated. In other words, extra tasks might be called out because of the missing information. The information can be provided later using the edit feature at which time the program would then be retailored.

7.) Interrupting a Session

A session can be interrupted prior to completing the questioning by typing the key word "stop". The system will prompt for a file identifier and will save the consultation to be resumed at a later time.

8.) Resuming a Session

To resume the user starts CATSOP as described earlier and proceeds by selecting the resume option from the first menu. The system will prompt for the date and the file identifier and will then continue the consultation where it left off.

9.) Displaying the Tailored Results

The system provides two reports which are saved in text files upon leaving CATSOP. These reprots are the tailored results and the contracting authority supplied data report. The user may view either of these reports before terminating a session. The sample log session illustrates the use of the display option to view the tailored results. Note that the tailoring results will indicate if the recommendation was based on incomplete information ie. the user answered "unknown" to certain questions.

10.) Overriding the Tailored Results

If not completely satisfied with the tailored output the user may override the system by adding or deleting tasks to any of the R/M/L Standards. In each case the system evaluates the implications of the user's actions and reports them to the user. The final decision to add/or delete the tasks is left to the user.

11.) Tailoring Inquiries

This feature allows the user to inquire about decisions made by the system. A complete trail of all decisions is available in the audit trail but, since that is generally several pages long, tailoring inquiries can be made regarding specific tasks. The user can inquire why a task is required, why a task was eliminated, what determined task qualifiers, and what determined a task rank. The system responds by searching the audit trail for the relevant entries. Samples of each type of inquiry are prcvided.

12) Ending a Session

A session is terminated by choosing EXIT from the User Options Menu. If the results have not been saved the system prompts to do so. The system saves the results by saving the memory, and then it logs the audit trail, tailored results, and contracting authority supplied data files.

II. Log of a Sample User Tailoring Session

```
CATSOP OPTION MENU
------------------
   0. EXIT CATSOP
   1. Tailor New Program
   2. Revise Previously Tailored Program
   3. Resume a Previous Session

Enter Desired Option:

CATSOP>1

Enter todays date:

CATSOP>6/14

Enter the program name:

CATSOP>test

Enter the solicitation number:

CATSOP>1234

Identify the program phase for the contract for which the
specifications are being tailored.
  1. Pre-concept Exploration
  2. Concept Exploration
  3. Demonstration/Validation
  4. Full Scale Development
  5. Production

CATSOP>2

Which standards do you wish to consider during this session?
  1. 1388-1a - Logistics Support Analysis
  2. 470a - Maintainability
  3. 785b - Reliability
  4. All Three Standards

CATSOP>3

Select one of the following which best describes the overall objective
of this contract.
  1. Develop Possible Concepts to Meet Statement of Need
  2. Provide Basis for Selecting System which Satisfies Mission
     Need and Warrants Further Development
  3. Verify Conceptual Results and Define System Sufficiently for
     Detailed Design
  4. Detailed Design/Development and Qualification
  5. Produce and Deploy

CATSOP>2
```

Select one of the following which best describes the objective of this contract so far as development of support characteristics are concerned.

1. No Consideration
2. Make-up as Possible Previous Shortcomings
3. Consistent with Equipment Development

CATSOP>explain

CONTRACT OBJECTIVE REGARDING SUPPORT

The answer to this question describes the overall objective of the contract so far as Reliability, Maintainability, and LSA are concerned. The degree of specific emphasis to be placed in each of the individual areas will be interpreted from the answer to the 'Budget' question.

Alternative	Definition
No Consideration	Objective is to establish some form of good basic Reliability and Maintainability features in the hardware design with no effort specifically directed toward LSA.
Make-up as Possible Previous Shortcomings	The information from previous phases (if applicable is incomplete and/or no longer applicable. The current objective is to complete those tasks to the extent necessary/ appropriate/possible and then provide the data consistent with the current phase.
Consistent with Equipment Development	Objective is to have an integrated R/M/L effort consistent with the intent of the three MIL-Standards according to the current program phase and/or status of the hardware development.

Press F5 to continue.
CATSOP>continue

Select one of the following which best describes the objective of this contract so far as development of support characteristics are concerned.

1. No Consideration
2. Make-up as Possible Previous Shortcomings
3. Consistent with Equipment Development

CATSOP>3

```
                                                                        2
The hardware level being contracted for in this procurement is:         2
  1. A Weapon System                                                    2
  2. A System/Subsystem                                                 2
  3. A First Level Replaceable Unit                                     2
       (LRU, WRA, LRA)                                                  2
  4. A Subassembly or Subassemblies of a First Level Replaceable Unit   2
       (SRU, SRA)                                                       2
                                                                        2
CATSOP>4                                                                2
                                                                        2
What best describes the hardware which is the subject of this contract? 2
  1. Existing Major Assemblies                                          2
  2. Simple Modification                                                2
  3. Major Modification                                                 2
  4. New Design - Existing State of the Art                             2
  5. New Design - New Materials/Processes                               2
  6. New Design - Advanced State of the Art                             2
                                                                        2
CATSOP>3                                                                2
                                                                        2
 What best describes the application of the hardware which is the       2
 subject of this contract?                                              2
  1. Existing Application                                               2
  2. Modified Application                                               2
  3. New Application                                                    2
                                                                        2
CATSOP>2                                                                2
                                                                        2
What is the total number of types of contract 'end items' planned       2
to be produced under this contract?                                     2
                                                                        2
CATSOP>catsop-help                                                      4
                                                                        4
                                                                        4
CATSOP HELP MENU                                                        4
----------------                                                        4
  0.  Exit CATSOP Help                                                  4
  1.  CATSOP Features                                                   4
  2.  CATSOP KB Terms                                                   4
                                                                        4
Enter Desired Option:                                                   4
                                                                        4
CATSOP>1                                                                4
```

CATSOP Features Menu
---

0. Exit CATSOP Features
1. Interrupts/Function Keys
2. CATSOP Help
3. Explaining the Question
4. Audit Trail
5. Tailoring Inquiries
6. Volunteering Data
7. Editing Answers
8. Override Tailored Results
9. Hardcopy Output

Enter Desired Option:
CATSOP>1

Interrupts/Function Keys

CATSOP responds to several interrupts which can be issued by the user from any CATSOP prompt. Some of these interrupts are provided by M.1 and other have been added to satisfy specific CATSOP requirements. At the bottom of the consultation window function keys are identified for use during a CATSOP consultation. The function keys are summarized as follows:

F1 CATSOP - Interrupts the consultation and takes the user to the CATSOP Help Menu.
F2 Scroll - Allows the user to scroll back the screen output.
F4 Explain - Interrupts to provide the user with explanations to consultation questions.
F5 Continue - Used to continue displays or the consultation when prompted by the system.
F10 Menus - Interrupt which activates the M.1 pull-down menus.

Press F5 to continue.
CATSOP>continue

Interrupts/Function Keys

The pull-down menu feature is one provided by M.1 as a means of accessing the M.1 operating system. The commands are divided into four categories which are shown at the top of the consultation window. When activated using F10, the menus expand. The arrow keys on the keyboard are used to move about and make a selection. These menus have been customized to include the CATSOP-Help and Explain interrupts along with some others including Abort (leave consultation without saving), Stop (leaves but saves work), and Audit (displays the CATSOP audit trail).
The key words CATSOP, Explain, Abort, Stop and Audit can also be typed at any CATSOP prompt to activate the interrupt. The interrupt will be processed and on completion the consultation will resume by reprompting for its next desired input.

```
Press F5 to continue.                                                    4
CATSOP>continue                                                          4
                                                                         4
CATSOP Features Menu                                                     4
--------------------                                                     4
  0.  Exit CATSOP Features                                               4
  1.  Interrupts/Function Keys                                           4
  2.  CATSOP Help                                                        4
  3.  Explaining the Question                                            4
  4.  Audit Trail                                                        4
  5.  Tailoring Inquiries                                                4
  6.  Volunteering Data                                                  4
  7.  Editing Answers                                                    4
  8.  Override Tailored Results                                          4
  9.  Hardcopy Output                                                    4
                                                                         4
Enter Desired Option:                                                    4
CATSOP>7                                                                 4
                                                                         4
                              Editing Answers                            4
                              ---------------                            4
                                                                         4
  The user can selectively change the answer to any tailoring question   4
  using this feature which is available from the User Options Menu.  A   4
  menu summarizing all the tailoring question will appear. The user may  4
  choose the one he wishes to revise and will prompted for his new       4
  answer.  Upon exiting the edit menu, CATSOP will retailor as           4
  necessary.                                                             4
                                                                         4
Press F5 to continue.                                                    4
CATSOP>continue                                                          4
                                                                         4
                                                                         4
CATSOP Features Menu                                                     4
--------------------                                                     4
  0.  Exit CATSOP Features                                               4
  1.  Interrupts/Function Keys                                           4
  2.  CATSOP Help                                                        4
  3.  Explaining the Question                                            4
  4.  Audit Trail                                                        4
  5.  Tailoring Inquiries                                                4
  6.  Volunteering Data                                                  4
  7.  Editing Answers                                                    4
  8.  Override Tailored Results                                          4
  9.  Hardcopy Output                                                    4
                                                                         4
Enter Desired Option:                                                    4
CATSOP>6                                                                 4
```

```
                                                                    4
                        Data Volunteering                           4
                        -----------------                           4
                                                                    4
  The data volunteering feature allows the user to volunteer answers to 4
  questions before the system asks the questions.  The user must wait 4
  until he is prompted for the program name before he can volunteer 4
  data.  A special syntax must be used when volunteering data.  The 4
  volunteer data command is as follows:                             4
                                                                    4
  set volunteer(TERM) = VALUE                                       4
                                                                    4
  where TERM is the knowledge base (kb) term that is to be set and  4
  VALUE is the value to which the kb term is set.  See the KB Terms 4
  section of help for a listing of the valid kb terms that can be   4
  volunteered.                                                      4
                                                                    4
                                                                    4
Press F5 to continue.                                               4
CATSOP>continue                                                     4
                                                                    4
                                                                    4
CATSOP Features Menu                                                4
--------------------                                                4
  0.  Exit CATSOP Features                                          4
  1.  Interrupts/Function Keys                                      4
  2.  CATSOP Help                                                   4
  3.  Explaining the Question                                       4
  4.  Audit Trail                                                   4
  5.  Tailoring Inquiries                                           4
  6.  Volunteering Data                                             4
  7.  Editing Answers                                               4
  8.  Override Tailored Results                                     4
  9.  Hardcopy Output                                               4
                                                                    4
Enter Desired Option:                                               4
CATSOP>0                                                            4
                                                                    4
CATSOP HELP MENU                                                    4
---------------                                                     4
  0.  Exit CATSOP Help                                              4
  1.  CATSOP Features                                               4
  2.  CATSOP KB Terms                                               4
                                                                    4
Enter Desired Option:                                               4
                                                                    4
CATSOP>2                                                            4
                                                                    4
```

```
Knowledge Base Terms                                                    4
--------------------                                                    4
 0. EXIT Menu                        15. budget-constraint(std)         4
 1. todays-date                      16. schedule-constraint            4
 2. program-name                     17. previous-are-consistent(std),  4
 3. solicitation-number              18. previous-less-consistent(std)  4
 4. program-phase                    19. established-specifications     4
 5. standards-to-consider            20. design-difficulty(reliability) 4
 6. contract-objective               21. design-difficulty(maintainability)
 7. contract-support-objective       22. equipment-use                  4
 8. hardware-level                   23. failure-criticality            4
 9. equipment-description                                               4
10. application-description                                             4
11. planned-items-types                                                 4
12. planned-items-average                                               4
13. fielded-items-types                                                 4
14. fielded-items-average                                               4
                                                                        4
Enter Desired Knowledge Base Term:                                      4
                                                                        4
CATSOP>16                                                               4
                                                                        4
Term: schedule-constraint                                               4
Legal Values: [normal,short,very-short]                                 4
[                                                                       4
The projected overall schedule for this contract is considered by       4
program analysts to be:                                                 4
  1. Normal                                                             4
  2. Short                                                              4
  3. Very Short                                                         4
]                                                                       4
                                                                        4
Press F5 to continue.                                                   4
CATSOP>continue                                                         4
                                                                        4
Knowledge Base Terms                                                    4
--------------------                                                    4
 0. EXIT Menu                        15. budget-constraint(std)         4
 1. todays-date                      16. schedule-constraint            4
 2. program-name                     17. previous-are-consistent(std),  4
 3. solicitation-number              18. previous-less-consistent(std)  4
 4. program-phase                    19. established-specifications     4
 5. standards-to-consider            20. design-difficulty(reliability) 4
 6. contract-objective               21. design-difficulty(maintainability)
 7. contract-support-objective       22. equipment-use                  4
 8. hardware-level                   23. failure-criticality            4
 9. equipment-description                                               4
10. application-description                                             4
11. planned-items-types                                                 4
12. planned-items-average                                               4
13. fielded-items-types                                                 4
14. fielded-items-average                                               4
                                                                        4
Enter Desired Knowledge Base Term:                                      4
CATSOP>0                                                                4
```

```
                                                                        4
CATSOP HELP MENU                                                        4
----------------                                                        4
  0.  Exit CATSOP Help                                                  4
  1.  CATSOP Features                                                   4
  2.  CATSOP KB Terms                                                   4
                                                                        4
Enter Desired Option:                                                   4
                                                                        4
CATSOP>0                                                                4
                                                                        5
What is the total number of types of contract 'end items' planned       5
to be produced under this contract?                                     5
                                                                        5
CATSOP>set vlounteer(schedule-constraint) = short                       5
                                                                        5
What is the total number of types of contract 'end items' planned       2
to be produced under this contract?                                     2
                                                                        2
CATSOP>1                                                                2
                                                                        2
What is the average number of each type of contract 'end item' planned  2
to be produced under this contract?                                     2
                                                                        2
CATSOP>3                                                                2
                                                                        2
What is the total number of types of contract 'end items' expected      2
to be fielded?                                                          2
                                                                        2
CATSOP>1                                                                2
                                                                        6
What is the average number of each type of contract 'end item' expected 6
to be fielded?                                                          6
                                                                        6
CATSOP>u                                                                6
                                                                        6
Reliability (MIL-STD-785B)                                              2
Expected budget for program is:                                         2
  1. Normal                                                             2
  2. Limited                                                            2
  3. Very Limited                                                       2
  4. Unknown                                                            2
                                                                        2
CATSOP>1                                                                2
                                                                        2
```

```
The contracted equipment will be utilized in:
  1. Ground Support/Test
  2. Ground Primary Equipment
  3. Spacecraft Manned
  4. Spacecraft Unmanned
  5. Airborne Inhabited
  6. Airborne Uninhabited
  7. Missile Launch
  8. Missile Free Flight
  9. Manpack

CATSOP>1

Catastrophic failure of the equipment will result in:
  1. Loss of Life
  2. Mission Abort
  3. Loss of Function/Degradation of Mission
  4. Loss of Redundancy/No Loss of Function
  5. No Detectable Effect on Any Required Function or Overall Mission
     Success

CATSOP>5

Which of the following specifications have been established for the
equipment which is the subject of this contract?
  1. Reliability Specification
  2. Maintainability Specification (including Diagnostics)
  3. Overall Logistics Concepts (ie. Deployment and Maintenance Plans)
  4. None

CATSOP>stop

Enter the file identifier.  (Enter 'cancel' or 'unknown' to cancel)

CATSOP>tim3_2



from dos prompt >catsop


CATSOP OPTION MENU
------------------
   0. EXIT CATSOP
   1. Tailor New Program
   2. Revise Previously Tailored Program
   3. Resume a Previous Session

Enter Desired Option:

CATSOP>3

Enter todays date:

CATSOP>6/15
```

```
                                                                          8
Enter the file identifier.  (Enter 'cancel' or 'unknown' to cancel)       8
                                                                          8
CATSOP>tim3_2                                                             8
                                                                          2
Which of the following specifications have been established for the       2
equipment which is the subject of this contract?                          2
  1. Reliability Specification                                            2
  2. Maintainability Specification (including Diagnostics)                2
  3. Overall Logistics Concepts (ie. Deployment and Maintenance Plans)    2
  4. None                                                                 2
                                                                          2
CATSOP>4                                                                  2
                                                                          2
Tailoring  MIL-STD-785B...                                                2
                                                                          2
Individual Tailoring completed.                                           2
                                                                          2
                                                                          2
Checking for linkages to MIL-STD-1388-1A                                  2
Checking for linkages to MIL-STD-470A                                     2
                                                                          2
USER OPTIONS MENU                                                         9
-----------------                                                         9
  0. EXIT User Options                                                    9
  1. Display Results                                                      9
  2. Edit Answers                                                         9
  3. Override Tailored Results                                            9
  4. Tailoring Inquiries                                                  9
  5. Save Results                                                         9
                                                                          9
Enter Desired Option:                                                     9
                                                                          9
CATSOP>1                                                                  9
                                                                          9
```

```
DISPLAY OPTION MENU                                                    9
------------------                                                     9
   0. EXIT Menu                                                        9
   1. Tailored Results                                                 9
   2. Contracting Authority Support Data                               9
                                                                       9
Enter Desired Option:                                                  9
                                                                       9
CATSOP>1                                                               9
                                                                       9
Which standards do you wish to display?                                9
  1. 1388-1a - Logistics Support Analysis                              9
  2. 470a - Maintainability                                            9
  3. 785b - Reliability                                                9
  4. All Three Standards                                               9
                                                                       9
CATSOP>3                                                               9
                                                                       9
Program Name: test                                                     9
Program Phase: Concept Exploration                                     9
Solicitation Number: 1234                                              9
Consultation Date: 6/14                                                9
                                                                       9
                CATSOP Tailoring Recommendation                        9
                -------------------------------                        9
                                                                       9
MIL-STD-785B                                                           9
                                                                       9
Task 101 - Reliability Program Plan                                    9
                                                                       9
  Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)             9
                                                                       9
Task 102 - Monitor/Control of Subcontractors and Suppliers             9
                                                                       9
  Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)             9
                                                                       9
  Qualifiers:                                                          9
                                                                       9
  Perform task to the extent that subcontractor and supplier activity  9
  can impact meeting specification requirements.                       9
                                                                       9
Task 103 - Program Reviews                                             9
                                                                       9
  Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)             9
                                                                       9
Task 201 - Reliability Modeling                                        9
                                                                       9
  Cost Effectiveness Ranking: 3.0 (1-9: 9-least effective)             9
                                                                       9
Press F5 to continue.                                                  9
CATSOP>continue                                                        9
                                                                       9
```

```
Task 202 - Reliability Allocations                                    9
                                                                      9
  Cost Effectiveness Ranking: 4.0 (1-9: 9-least effective)            9
                                                                      9
  Qualifiers:                                                         9
                                                                      9
  Perform task only to the extent which is consistent with the hardware 9
  design activity of this phase.                                      9
                                                                      9
  Perform only if expected modification to equipment or application   9
  will impact previous effort already performed and available.        9
                                                                      9
Task 203 - Reliability Predictions                                    9
                                                                      9
  Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)            9
                                                                      9
  Qualifiers:                                                         9
                                                                      9
  Perform task only to the extent which is consistent with the hardware 9
  design activity of this phase.                                      9
                                                                      9
Task 207.2.1 - Parts Control Program                                  9
                                                                      9
  Cost Effectiveness Ranking: 3.0 (1-9: 9-least effective)            9
                                                                      9
  Qualifiers:                                                         9
                                                                      9
  Perform task only to the extent which is consistent with the hardware 9
  design activity of this phase.                                      9
                                                                      9
  Perform parts control program in accordance with MIL-STD-965        9
  procedure X (I or II).                                              9
                                                                      9
  Task performance should be consistant with previous task effort and 9
  sufficient to meet requirements.                                    9
                                                                      9
Task 207.2.2 - Reliability Design Guidelines                          9
                                                                      9
  Cost Effectiveness Ranking: 3.0 (1-9: 9-least effective)            9
                                                                      9
  Qualifiers:                                                         9
                                                                      9
  Perform task only to the extent which is consistent with the hardware 9
  design activity of this phase.                                      9
                                                                      9
  Task performance should be consistant with previous task effort and 9
  sufficient to meet requirements.                                    9
                                                                      9
Press F5 to continue.                                                 9
CATSOP>continue                                                       9
                                                                      9
```

```
Task 208 - Reliability Critical Items                                    9
                                                                         9
  Cost Effectiveness Ranking: 3.0 (1-9: 9-least effective)               9
                                                                         9
  Qualifiers:                                                            9
                                                                         9
  Perform task only to the extent which is consistent with the hardware  9
  design activity of this phase.                                         9
                                                                         9
  Task is required only if critical items are identified by the FMECA.   9
                                                                         9
                                                                         9
*** The following inputs were answered UNKNOWN:                          9
     fielded-items-average                                               9
                                                                         9
DISPLAY OPTION MENU                                                      9
------------------                                                       9
   0. EXIT Menu                                                          9
   1. Tailored Results                                                   9
   2. Contracting Authority Support Data                                 9
                                                                         9
Enter Desired Option:                                                    9
                                                                         9
CATSOP>0                                                                 9
                                                                         9
USER OPTIONS MENU                                                        10
-----------------                                                        10
  0. EXIT User Options                                                   10
  1. Display Results                                                     10
  2. Edit Answers                                                        10
  3. Override Tailored Results                                           10
  4. Tailoring Inquiries                                                 10
  5. Save Results                                                        10
                                                                         10
Enter Desired Option:                                                    10
                                                                         10
CATSOP>3                                                                 10
                                                                         10
CATSOP OVERRIDE MENU                                                     10
-------------------                                                      10
  0. Exit Menu                                                           10
  1. Add Tasks                                                           10
  2. Delete Tasks                                                        10
                                                                         10
Enter Desired Option:                                                    10
                                                                         10
CATSOP>1                                                                 10
                                                                         10
Select the desired standard.                                             10
  1. 1388-1a - Logistics Support Analysis                                10
  2. 470a - Maintainability                                              10
  3. 785b - Reliability                                                  10
                                                                         10
CATSOP>3                                                                 10
```

```
Enter the task number in the form TASK-SUBTASK.                    10
                                                                   10
CATSOP>205                                                         10
                                                                   10
You have requested the following tasks be added:                   10
   MIL-STD-785B Task 205 Sneak Circuit Analysis (SCA)              10
                                                                   10
Would you like to add another?                                     10
                                                                   10
CATSOP>y                                                           10
                                                                   10
Select the desired standard.                                       10
  1. 1388-1a - Logistics Support Analysis                          10
  2. 470a - Maintainability                                        10
  3. 785b - Reliability                                            10
                                                                   10
CATSOP>3                                                           10
                                                                   10
Enter the task number in the form TASK-SUBTASK.                    10
                                                                   10
CATSOP>206                                                         10
                                                                   10
You have requested the following tasks be added:                   10
   MIL-STD-785B Task 205 Sneak Circuit Analysis (SCA)              10
   MIL-STD-785B Task 206 Electronic Parts/Circuits Tolerance Analysis 10
                                                                   10
Would you like to add another?                                     10
                                                                   10
CATSOP>n                                                           10
                                                                   10
MIL-STD-785B Task 205 requires MIL-STD-785B Task 204 Failure Modes, 10
Effects, and Criticality Analysis (FMECA).                         10
                                                                   10
Addition of MIL-STD-785B Task 204 does not effect any another tasks. 10
Addition of MIL-STD-785B Task 206 does not effect any another tasks. 10
                                                                   10
Do you wish to add MIL-STD-785B Task 205 Sneak Circuit Analysis (SCA)? 10
CATSOP>y                                                           10
                                                                   10
Do you wish to add MIL-STD-785B Task 204 Failure Modes, Effects,   10
and Criticality Analysis (FMECA)?                                  10
CATSOP>y                                                           10
                                                                   10
Do you wish to add MIL-STD-785B Task 206 Electronic Parts/Circuits 10
Tolerance Analysis?                                                10
CATSOP>y                                                           10
```

```
CATSOP OVERRIDE MENU                                                    10
--------------------                                                    10
  0. Exit Menu                                                          10
  1. Add Tasks                                                          10
  2. Delete Tasks                                                       10
                                                                        10
Enter Desired Option:                                                   10
                                                                        10
CATSOP>2                                                                10
                                                                        10
CATSOP DELETE OVERRIDE MENU                                             10
---------------------------                                             10
  1. CATSOP Recommendation                                              10
  2. User Selection                                                     10
                                                                        10
Enter Desired Option:                                                   10
                                                                        10
CATSOP>1                                                                10
                    Task Deletion Impact Report                         10
                                                                        10
MIL-STD-785B  TASK 204 - Failure Modes,  Effects,  and  Criticality     10
Analysis (FMECA)                                                        10
                                                                        10
Cost Effectiveness Ranking: 9.0 (1-9: 9-least effective)                10
                                                                        10
Impact of Task Deletion:                                                10
                                                                        10
   This task identifies potential weaknesses of the proposed design.    10
   Failure to accomplish this task eliminates the opportunity to        10
   correct these weaknesses, provide diagnostics to detect them when    10
   they occur, and/or provide the proper support equipment or other     10
   resource for their repair and return to service.                     10
                                                                        10
Deletion of MIL-STD-785B Task 204 will impact MIL-STD-785B Task 208     10
Reliability Critical Items.                                             10
                                                                        10
Deletion of MIL-STD-785B Task 204 will impact MIL-STD-785B Task 205     10
Sneak Circuit Analysis (SCA).                                           10
                                                                        10
Press F5 to continue.                                                   10
CATSOP>continue                                                         10
                                                                        10
                    Task Deletion Impact Report                         10
                                                                        10
MIL-STD-785B TASK 205 - Sneak Circuit Analysis (SCA)                    10
                                                                        10
Cost Effectiveness Ranking: 9.0 (1-9: 9-least effective)                10
                                                                        10
Impact of Task Deletion:                                                10
                                                                        10
Upon  deletion of MIL-STD-785B Task 205 MIL-STD-785B Task 204 Failure   10
Modes, Effects, and Criticality Analysis (FMECA) is no longer needed.   10
                                                                        10
Press F5 to continue.                                                   10
CATSOP>continue                                                         10
```

```
                    Task Deletion Impact Report                          10
                                                                         10
MIL-STD-785B TASK 206 - Electronic Parts/Circuits Tolerance Analysis     10
                                                                         10
Cost Effectiveness Ranking: 9.0 (1-9: 9-least effective)                 10
                                                                         10
Impact of Task Deletion:                                                 10
                                                                         10
Press F5 to continue.                                                    10
CATSOP>continue                                                          10
                                                                         10
                    Task Deletion Impact Report                          10
                                                                         10
MIL-STD-785B TASK 202 - Reliability Allocations                          10
                                                                         10
Cost Effectiveness Ranking: 4.0 (1-9: 9-least effective)                 10
                                                                         10
Impact of Task Deletion:                                                 10
                                                                         10
   This task is required if the design responsibility is assigned to a   10
   lower indenture hardware level than the level specified in the        10
   procurement document.  Without it, the sub-tier contribution to the   10
   top level requirement cannot be established as a design-to            10
   requirement.  The impact is the possibility of improperly             10
   apportioned reliability design activities.                            10
                                                                         10
                                                                         10
Deletion  of MIL-STD-785B Task 202 will impact MIL-STD-785B Task 103     10
Program Reviews.                                                         10
                                                                         10
Deletion of MIL-STD-785B Task 202 will impact MIL-STD-785B Task 203      10
Reliability Predictions.                                                 10
                                                                         10
Deletion of MIL-STD-785B Task 202 will impact MIL-STD-785B Task 207.2.2  10
Reliability Design Guidelines.                                           10
                                                                         10
Press F5 to continue.                                                    10
CATSOP>continue                                                          10
                                                                         10
                                                                         10
Do you wish to delete MIL-STD-785B Task 204 Failure Modes, Effects, and  10
Criticality Analysis (FMECA)?                                            10
CATSOP>n                                                                 10
                                                                         10
Do you wish to delete MIL-STD-785B Task 205 Sneak Circuit Analysis       10
(SCA)?                                                                   10
CATSOP>n                                                                 10
                                                                         10
Do you wish to delete MIL-STD-785B Task 206 Electronic Parts/Circuits    10
Tolerance Analysis?                                                      10
CATSOP>n                                                                 10
                                                                         10
Do you wish to delete MIL-STD-785B Task 202 Reliability Allocations?     10
CATSOP>y                                                                 10
```

```
CATSOP OVERRIDE MENU                                                    10
--------------------                                                    10
  0. Exit Menu                                                          10
  1. Add Tasks                                                          10
  2. Delete Tasks                                                       10
                                                                        10
Enter Desired Option:                                                   10
                                                                        10
CATSOP>2                                                                10
                                                                        10
CATSOP DELETE OVERRIDE MENU                                             10
---------------------------                                             10
  1. CATSOP Recommendation                                              10
  2. User Selection                                                     10
                                                                        10
Enter Desired Option:                                                   10
                                                                        10
CATSOP>2                                                                10
                                                                        10
Select the desired standard.                                            10
  1. 1388-1a - Logistics Support Analysis                               10
  2. 470a - Maintainability                                             10
  3. 785b - Reliability                                                 10
                                                                        10
CATSOP>3                                                                10
                                                                        10
Enter the task number in the form TASK-SUBTASK.                         10
                                                                        10
CATSOP>103                                                              10
                                                                        10
Candidate task for deletion are:                                        10
   MIL-STD-785B Task 103 Program Reviews                                10
                                                                        10
Would you like to delete another?                                       10
                                                                        10
CATSOP>n                                                                10
                                                                        10
                    Task Deletion Impact Report                         10
                                                                        10
MIL-STD-785B TASK 103 - Program Reviews                                 10
                                                                        10
Cost Effectiveness Ranking: 1.0 (1-9: 9-least effective)                10
                                                                        10
Impact of Task Deletion:                                                10
                                                                        10
   Program reviews include participation in system reviews and special  10
   reliability program reviews as applicable.  Detailing this task      10
   sends the message to the responsible engineers that reliability is   10
   not important.  The risk increases that reliability requirements     10
   will not be met.                                                     10
                                                                        10
                                                                        10
Press F5 to continue.                                                   10
CATSOP>continue                                                         10
                                                                        10
```

```
Do you wish to delete MIL-STD-785B Task 103 Program Reviews?
CATSOP>y

CATSOP OVERRIDE MENU
--------------------
  0. Exit Menu
  1. Add Tasks
  2. Delete Tasks

Enter Desired Option:

CATSOP>0

USER OPTIONS MENU
-----------------
  0. EXIT User Options
  1. Display Results
  2. Edit Answers
  3. Override Tailored Results
  4. Tailoring Inquiries
  5. Save Results

Enter Desired Option:

CATSOP>4

INQUIRY OPTION MENU
-------------------
   0. EXIT Menu
   1. Why was a task required?
   2. Why was a task eliminated?
   3. What determined a tasks qualifers?
   4. What determined a tasks rank?

Enter Desired Option:

CATSOP>1

Select the desired standard.
  1. 1388-1a - Logistics Support Analysis
  2. 470a - Maintainability
  3. 785b - Reliability

CATSOP>3

Enter the task number in the form TASK-SUBTASK.

CATSOP>204

The user confirmed to add Task 204 to MIL-STD-785B
  to satisfy a linkage to MIL-STD-785B Task 205.
```

```
INQUIRY OPTION MENU                                                    11
-------------------                                                    11
   0. EXIT Menu                                                        11
   1. Why was a task required?                                         11
   2. Why was a task eliminated?                                       11
   3. What determined a tasks qualifers?                               11
   4. What determined a tasks rank?                                    11
                                                                       11
Enter Desired Option:                                                  11
                                                                       11
CATSOP>2                                                               11
                                                                       11
Select the desired standard.                                           11
  1. 1388-1a - Logistics Support Analysis                              11
  2. 470a - Maintainability                                            11
  3. 785b - Reliability                                                11
                                                                       11
CATSOP>3                                                               11
                                                                       11
Enter the task number in the form TASK-SUBTASK.                        11
                                                                       11
CATSOP>202                                                             11
                                                                       11
The user overrode the system by deleting Task 202 from MIL-STD-785B.   11
                                                                       11
INQUIRY OPTION MENU                                                    11
-------------------                                                    11
   0. EXIT Menu                                                        11
   1. Why was a task required?                                         11
   2. Why was a task eliminated?                                       11
   3. What determined a tasks qualifers?                               11
   4. What determined a tasks rank?                                    11
                                                                       11
Enter Desired Option:                                                  11
                                                                       11
CATSOP>2                                                               11
                                                                       11
Select the desired standard.                                           11
  1. 1388-1a - Logistics Support Analysis                              11
  2. 470a - Maintainability                                            11
  3. 785b - Reliability                                                11
                                                                       11
CATSOP>3                                                               11
                                                                       11
Enter the task number in the form TASK-SUBTASK.                        11
                                                                       11
CATSOP>301                                                             11
                                                                       11
The tailor-r-concept-phase-rule eliminated the following tasks from    11
MIL-STD-785B because they are not applicable to this program phase:    11
     205, 206, 209, 301, 302, 303, 304.                                11
```

```
INQUIRY OPTION MENU                                                    11
------------------                                                     11
   0. EXIT Menu                                                        11
   1. Why was a task required?                                         11
   2. Why was a task eliminated?                                       11
   3. What determined a tasks qualifers?                               11
   4. What determined a tasks rank?                                    11
                                                                       11
Enter Desired Option:                                                  11
                                                                       11
CATSOP>3                                                               11
                                                                       11
Select the desired standard.                                           11
  1. 1388-1a - Logistics Support Analysis                              11
  2. 470a - Maintainability                                            11
  3. 785b - Reliability                                                11
                                                                       11
CATSOP>3                                                               11
                                                                       11
Enter the task number in the form TASK-SUBTASK.                        11
                                                                       11
CATSOP>207-2                                                           11
                                                                       11
This qualifier was identified for MIL-STD-785B Task 207.2.2 using this 11
rule.                                                                  11
tailor-r-qual-rule-1-207-2:                                            11
    if program-phase = concept or                                      11
       program-phase = demo-valid                                      11
    then qualifier(std_785b-207-2) = q00001-1.                         11
                                                                       11
  Perform task only to the extent which is consistent with the hardware 11
  design activity of this phase.                                       11
                                                                       11
This qualifier was identified for MIL-STD-785B Task 207.2.2 using this 11
rule.                                                                  11
tailor-r-qual-rule-2-207-2:                                            11
    if equipment-description = major-mod                               11
    then qualifier(std_785b-207-2) = q00006-2.                         11
                                                                       11
  Task performance should be consistant with previous task effort and  11
  sufficient to meet requirements.                                     11
                                                                       11
INQUIRY OPTION MENU                                                    11
------------------                                                     11
   0. EXIT Menu                                                        11
   1. Why was a task required?                                         11
   2. Why was a task eliminated?                                       11
   3. What determined a tasks qualifers?                               11
   4. What determined a tasks rank?                                    11
                                                                       11
Enter Desired Option:                                                  11
                                                                       11
CATSOP>4                                                               11
                                                                       11
```

```
Select the desired standard.                                          11
  1. 1388-1a - Logistics Support Analysis                             11
  2. 470a - Maintainability                                           11
  3. 785b - Reliability                                               11
                                                                      11
CATSOP>3                                                              11
                                                                      11
Enter the task number in the form TASK-SUBTASK.                       11
                                                                      11
CATSOP>206                                                            11
                                                                      11
The user overrode the system by adding Task 206 to MIL-STD-785B.      11
The default rank of 9 was assigned for this task.                     11
                                                                      11
INQUIRY OPTION MENU                                                   11
------------------                                                    11
   0. EXIT Menu                                                       11
   1. Why was a task required?                                        11
   2. Why was a task eliminated?                                      11
   3. What determined a tasks qualifers?                              11
   4. What determined a tasks rank?                                   11
                                                                      11
Enter Desired Option:                                                 11
                                                                      11
CATSOP>4                                                              11
                                                                      11
Select the desired standard.                                          11
  1. 1388-1a - Logistics Support Analysis                             11
  2. 470a - Maintainability                                           11
  3. 785b - Reliability                                               11
                                                                      11
CATSOP>3                                                              11
                                                                      11
Enter the task number in the form TASK-SUBTASK.                       11
                                                                      11
CATSOP>207-1                                                          11
                                                                      11
CATSOP determined 4.0 for the task-importance-factor of MIL-STD-785B  11
Task 207.2.1 using this rule.                                         11
tailor-r-tif-2-207-1:                                                 11
    if not established-specifications = reliability or                11
       (established-specifications = reliability and                  11
        (design-difficulty(reliability) = nominal or                  11
         design-difficulty(reliability) = unknown))                   11
    then task-importance-fctr(std_785b-207-1) = 4.0-2.                 11
                                                                      11
                                                                      11
The tailor-rm-compute-rank-rule rule determined the rank of 3.0 for   11
MIL-STD-785B Task 207-1.  The rank is computed as the product of the  11
rm-hardware-application-factor, rm-hardware-utilization-factor, and   11
task-importance-factor for this task.                                 11
```

```
INQUIRY OPTION MENU                                                    11
-------------------                                                    11
   0. EXIT Menu                                                        11
   1. Why was a task required?                                         11
   2. Why was a task eliminated?                                       11
   3. What determined a tasks qualifers?                               11
   4. What determined a tasks rank?                                    11
                                                                       11
Enter Desired Option:                                                  11
                                                                       11
CATSOP>0                                                               11
                                                                       11
USER OPTIONS MENU                                                      12
-----------------                                                      12
  0. EXIT User Options                                                 12
  1. Display Results                                                   12
  2. Edit Answers                                                      12
  3. Override Tailored Results                                         12
  4. Tailoring Inquiries                                               12
  5. Save Results                                                      12
                                                                       12
Enter Desired Option:                                                  12
                                                                       12
CATSOP>0                                                               12
                                                                       12
The latest results have not been saved.  Do you wish to save them?     12
                                                                       12
CATSOP>n                                                               12
                                                                       12
                                                                       12
End of consultation.                                                   12
```

III. Narrative Description of an Audit Trail

The CATSOP audit trail is available at any time during the consultation. It is invoked from the Logging/Audit pull-down menu. The audit trail is a series of records identifying:

1) the answers the user provided during questioning,
2) each tailoring action taken by the system in terms of what rules were used, and
3) all actions by the user to override the system.

The audit trail is a valuable tool for both the knowledge engineer and the end user. The knowledge engineer is the person who creates or modifies the rules. He uses the audit trail to test and debug knowledge base changes. The end user can reference the audit trail to see how his responses influence the system output. He can modify his answers and compare the resulting audit trails to see the affect of different answers. An example of each of the 12 various types of audit trail entries is provided and explained below.

1.) User Answer Example

Each answer to a tailoring question is recorded on the audit trail. The answer is associated with a knowledge base term and listed in the audit trail as follows.

> The user entered concept for program-phase.

2.) Phase Elimination

This entry identifies which tasks were eliminated solely on the basis of the program phase. The rule name is provided although the actual rule text is not listed because it is too long.

> The tailor-r-concept-phase-rule eliminated the following tasks from MIL-STD-785B because they are not applicable to this program phase: 205, 206, 209, 301, 302, 303, 304.

3.) General Elimination

This audit entry identifies a typical rule used to eliminate a task based on the answers provided.

```
Task 204 was eliminated from MIL-STD-785B using this rule.
tailor-r-elim-rule-1-204:
    if (hardware-level = subassembly and
        failure-criticality = no-detectable-effect) or
       (equipment-description = existing and
        application-description = existing)
    then elim(std_785b-204) = 1.
```

4.) Absence Elimination

This audit entry identifies a typical rule used to eliminate a task based on the absence of other tasks.

```
Task 105 was eliminated from MIL-STD-785B using this rule.
tailor-r-elim-rule-1-105:
    if tailored-tasks(std_785b) = std_785b-105 and
       not tailored-tasks(std_785b) = std_785b-301 and
       not tailored-tasks(std_785b) = std_785b-302 and
       not tailored-tasks(std_785b) = std_785b-303 and
       not tailored-tasks(std_785b) = std_785b-304
    then special-elim(std_785b-105) = 1.
```

5.) Hardware Application Factor

The following audit entry identifies the rule which fired to determine the hardware application factor which is needed to compute the task rankings.

```
CATSOP determined 18.0 for rm-hardware-appl-factor using this
rule.
tailor-rm-haf-8:
    if equipment-description = major-mod and
       schedule-constraint = short
    then rm-hardware-appl-fctr = 18.0-8.
```

6.) Hardware Utilization Factor

The following audit entry identifies the rule which fired to determine the hardware utilization factor which is needed to compute the task rankings.

```
CATSOP determined 0.04 for rm-hardware-util-factor using
this rule.
tailor-rm-huf-5:
    if (equipment-use = ground-support-test or
        equipment-use = ground-prime-equip) and
       failure-criticality = no-detectable-effect
    then rm-hardware-util-fctr = 0.04-5.
```

7.) Task Importance Factor

The following audit entry identifies the rule which fired to determine the task importance factor. This factor is also needed to compute the task rankings. In this case there is no rule premise meaning the fact is unconditional and the value is always 1.0.

```
CATSOP determined 1.0 for the task-importance-factor of
MIL-STD-785B Task 101 using this rule.
tailor-r-tif-1-101:
    task-importance-fctr(std_785b-101) = 1.0-1.
```

8.) Rank Computations

This audit entry identifies the value which was computed for a task rank. It states how the value was computed rather than showing the actual rule.

```
The tailor-rm-compute-rank-rule rule determined the rank of
1.0 for MIL-STD-785B Task 101. The rank is computed as the
product of the rm-hardware-application-factor,
rm-hardware-utilization-factor, and task-importance-factor
for this task.
```

9.) Budget Elimination

The following audit entry appears when a task is eliminated based on the budget constraint and the rank.

```
Task 101 was eliminated from MIL-Standard 785 because the budget
is limited and the cost effectiveness ranking is >= 8.
```

10.) Qualifiers

This next audit trail entry identifies the rule used to determine a qualifier code associated with a task. The text associated with the code is also printed for convenience.

```
This qualifier was identified for MIL-STD-785B Task 202
using this rule.
tailor-r-qual-rule-1-202:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-202) = q00001-1.

Perform task only to the extent which is consistent with
the hardware design activity of this phase.
```

When overriding the CATSOP recommendation, the system check for linkages to other tasks which are not present. The user must indicate whether to include the linkage task or not. The resulting audit entry appers when a linkage is confirmed to be added.

> The user confirmed to add Task 204 to MIL-STD-785B to satisfy a linkage to MIL-STD-785B Task 205.

11.) Override Additions

The following audit entry is included when tasks are added by the user.

> The user overrode the system by adding Task 205 to MIL-STD-785B. The default rank of 9 was assigned for this task.

12.) Override Deletions

The following audit entry is included when tasks are deleted by the user.

> The user overrode the system by deleting Task 202 from MIL-STD-785B.

IV. Audit Trail for Sample User Tailoring Session

The user entered test for program-name.

The user entered 1234 for solicitation-number.

The user entered concept for program-phase.

The user entered std_785b for standards-to-consider.

The user entered provide-basis for contract-objective.

The user entered equipment-consistency for contract-support-objective.

The user entered subassembly for hardware-level.

The user entered major-mod for equipment-description.

The user entered modified for application-description.

The user entered short for schedule-constraint.

The user entered 1 for planned-items-types.

The user entered 3 for planned-items-average.

The user entered 1 for fielded-items-types.

The user entered unknown for fielded-items-average.

The user entered normal for budget-constraint(std_785b).

The user entered ground-support-test for equipment-use.

The user entered no-detectable-effect for failure-criticality.

The user entered none for established-specifications.

The tailor-r-concept-phase-rule eliminated the following tasks from MIL-STD-785B because they are not applicable to this program phase:
205, 206, 209, 301, 302, 303, 304.

Task 204 was eliminated from MIL-STD-785B using this rule.
tailor-r-elim-rule-1-204:

```
if (hardware-level = subassembly and
    failure-criticality = no-detectable-effect) or
   (equipment-description = existing and
    application-description = existing)
then elim(std_785b-204) = 1.
```

```
Task 105 was eliminated from MIL-STD-785B using this rule.
tailor-r-elim-rule-1-105:
    if tailored-tasks(std_785b) = std_785b-105 and
       not tailored-tasks(std_785b) = std_785b-301 and
       not tailored-tasks(std_785b) = std_785b-302 and
       not tailored-tasks(std_785b) = std_785b-303 and
       not tailored-tasks(std_785b) = std_785b-304
    then special-elim(std_785b-105) = 1.


Task 104 was eliminated from MIL-STD-785B using this rule.
tailor-r-elim-rule-1-104:
    if tailored-tasks(std_785b) = std_785b-104 and
       not tailored-tasks(std_785b) = std_785b-301 and
       not tailored-tasks(std_785b) = std_785b-302 and
       not tailored-tasks(std_785b) = std_785b-303 and
       not tailored-tasks(std_785b) = std_785b-304
    then special-elim(std_785b-104) = 1.


CATSOP determined 18.0 for rm-hardware-appl-factor using this rule.
tailor-rm-haf-8:
    if equipment-description = major-mod and
       schedule-constraint = short
    then rm-hardware-appl-fctr = 18.0-8.


CATSOP determined 0.04 for rm-hardware-util-factor using this rule.
tailor-rm-huf-5:
    if (equipment-use = ground-support-test or
        equipment-use = ground-prime-equip) and
       failure-criticality = no-detectable-effect
    then rm-hardware-util-fctr = 0.04-5.


CATSOP determined 1.0 for the task-importance-factor of MIL-STD-785B
Task 101 using this rule.
tailor-r-tif-1-101:
    task-importance-fctr(std_785b-101) = 1.0-1.


The tailor-rm-compute-rank-rule rule determined the rank of 1.0 for
MIL-STD-785B Task 101.  The rank is computed as the product of the
rm-hardware-application-factor, rm-hardware-utilization-factor, and
task-importance-factor for this task.

CATSOP determined 1.0 for the task-importance-factor of MIL-STD-785B
Task 102 using this rule.
tailor-r-tif-1-102:
    task-importance-fctr(std_785b-102) = 1.0-1.
```

The tailor-rm-compute-rank-rule rule determined the rank of 1.0 for MIL-STD-785B Task 102. The rank is computed as the product of the rm-hardware-application-factor, rm-hardware-utilization-factor, and task-importance-factor for this task.

CATSOP determined 1.0 for the task-importance-factor of MIL-STD-785B Task 103 using this rule.

```
tailor-r-tif-1-103:
    task-importance-fctr(std_785b-103) = 1.0-1.
```

The tailor-rm-compute-rank-rule rule determined the rank of 1.0 for MIL-STD-785B Task 103. The rank is computed as the product of the rm-hardware-application-factor, rm-hardware-utilization-factor, and task-importance-factor for this task.

CATSOP determined 4.0 for the task-importance-factor of MIL-STD-785B Task 201 using this rule.

```
tailor-r-tif-2-201:
    if not established-specifications = reliability or
       (established-specifications = reliability and
        (design-difficulty(reliability) = nominal or
         design-difficulty(reliability) = unknown))
    then task-importance-fctr(std_785b-201) = 4.0-2.
```

The tailor-rm-compute-rank-rule rule determined the rank of 3.0 for MIL-STD-785B Task 201. The rank is computed as the product of the rm-hardware-application-factor, rm-hardware-utilization-factor, and task-importance-factor for this task.

CATSOP determined 5.0 for the task-importance-factor of MIL-STD-785B Task 202 using this rule.

```
tailor-r-tif-2-202:
    if not established-specifications = reliability or
       (established-specifications = reliability and
        (design-difficulty(reliability) = nominal or
         design-difficulty(reliability) = unknown))
    then task-importance-fctr(std_785b-202) = 5.0-2.
```

The tailor-rm-compute-rank-rule rule determined the rank of 4.0 for MIL-STD-785B Task 202. The rank is computed as the product of the rm-hardware-application-factor, rm-hardware-utilization-factor, and task-importance-factor for this task.

CATSOP determined 1.0 for the task-importance-factor of MIL-STD-785B Task 203 using this rule.

```
tailor-r-tif-2-203:
    if not established-specifications = reliability or
       (established-specifications = reliability and
        (design-difficulty(reliability) = nominal or
         design-difficulty(reliability) = unknown))
    then task-importance-fctr(std_785b-203) = 1.0-2.
```

The tailor-rm-compute-rank-rule rule determined the rank of 1.0 for MIL-STD-785B Task 203. The rank is computed as the product of the rm-hardware-application-factor, rm-hardware-utilization-factor, and task-importance-factor for this task.

CATSOP determined 4.0 for the task-importance-factor of MIL-STD-785B Task 207.2.1 using this rule.

```
tailor-r-tif-2-207-1:
    if not established-specifications = reliability or
       (established-specifications = reliability and
        (design-difficulty(reliability) = nominal or
         design-difficulty(reliability) = unknown))
    then task-importance-fctr(std_785b-207-1) = 4.0-2.
```

The tailor-rm-compute-rank-rule rule determined the rank of 3.0 for MIL-STD-785B Task 207-1. The rank is computed as the product of the rm-hardware-application-factor, rm-hardware-utilization-factor, and task-importance-factor for this task.

CATSOP determined 4.0 for the task-importance-factor of MIL-STD-785B Task 207.2.2 using this rule.

```
tailor-r-tif-2-207-2:
    if not established-specifications = reliability or
       (established-specifications = reliability and
        (design-difficulty(reliability) = nominal or
         design-difficulty(reliability) = unknown))
    then task-importance-fctr(std_785b-207-2) = 4.0-2.
```

The tailor-rm-compute-rank-rule rule determined the rank of 3.0 for MIL-STD-785B Task 207-2. The rank is computed as the product of the rm-hardware-application-factor, rm-hardware-utilization-factor, and task-importance-factor for this task.

```
CATSOP determined 3.0 for the task-importance-factor of MIL-STD-785B
Task 208 using this rule.
tailor-r-tif-2-208:
    if not established-specifications = reliability or
       (established-specifications = reliability and
        (design-difficulty(reliability) = nominal or
         design-difficulty(reliability) = unknown))
    then task-importance-fctr(std_785b-208) = 3.0-2.


The tailor-rm-compute-rank-rule rule determined the rank of 3.0 for
MIL-STD-785B Task 208.  The rank is computed as the product of the
rm-hardware-application-factor, rm-hardware-utilization-factor, and
task-importance-factor for this task.

This qualifier was identified for MIL-STD-785B Task 102 using this
rule.
tailor-r-qual-rule-1-102:
    if tailored-tasks(std_785b) = std_785b-102
    then qualifier(std_785b-102) = q00009-1.

  Perform task to the extent that subcontractor and supplier activity
can
  impact meeting specification requirements.

This qualifier was identified for MIL-STD-785B Task 202 using this
rule.
tailor-r-qual-rule-1-202:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-202) = q00001-1.

  Perform task only to the extent which is consistent with the hardware
  design activity of this phase.

This qualifier was identified for MIL-STD-785B Task 202 using this
rule.
tailor-r-qual-rule-3-202:
    if equipment-description = major-mod or
       equipment-description = simple-mod
    then qualifier(std_785b-202) = q00002-3.

  Perform only if expected modification to equipment or application
will
  impact previous effort already performed and available.
```

```
This qualifier was identified for MIL-STD-785B Task 203 using this
rule.
tailor-r-qual-rule-1-203:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-203) = q00001-1.

  Perform task only to the extent which is consistent with the hardware
  design activity of this phase.

This qualifier was identified for MIL-STD-785B Task 207.2.1 using this
rule.
tailor-r-qual-rule-1-207-1:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-207-1) = q00001-1 and
         qualifier(std_785b-207-1) = q00005-1.

  Perform task only to the extent which is consistent with the hardware
  design activity of this phase.

This qualifier was identified for MIL-STD-785B Task 207.2.1 using this
rule.
tailor-r-qual-rule-1-207-1:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-207-1) = q00001-1 and
         qualifier(std_785b-207-1) = q00005-1.

  Perform parts control program in accordance with MIL-STD-965
procedure
  X (I or II).

This qualifier was identified for MIL-STD-785B Task 207.2.1 using this
rule.
tailor-r-qual-rule-2-207-1:
    if program-phase = production or
       not hardware-level = subassembly or
       budget-constraint(std_785b) = limited or
       equipment-description = major-mod or
       equipment-description = new-existing or
       equipment-description = new-materials or
       equipment-description = new-advanced
    then qualifier(std_785b-207-1) = q00005-2.

  Perform parts control program in accordance with MIL-STD-965
procedure
  X (I or II).
```

```
This qualifier was identified for MIL-STD-785B Task 207.2.1 using this
rule.
tailor-r-qual-rule-4-207-1:
    if equipment-description = major-mod
    then qualifier(std_785b-207-1) = q00006-4.

  Task performance should be consistant with previous task effort and
  sufficient to meet requirements.

This qualifier was identified for MIL-STD-785B Task 207.2.2 using this
rule.
tailor-r-qual-rule-1-207-2:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-207-2) = q00001-1.

  Perform task only to the extent which is consistent with the hardware
  design activity of this phase.

This qualifier was identified for MIL-STD-785B Task 207.2.2 using this
rule.
tailor-r-qual-rule-2-207-2:
    if equipment-description = major-mod
    then qualifier(std_785b-207-2) = q00006-2.

  Task performance should be consistant with previous task effort and
  sufficient to meet requirements.

This qualifier was identified for MIL-STD-785B Task 208 using this
rule.
tailor-r-qual-rule-1-208:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-208) = q00001-1 and
         qualifier(std_785b-208) = q00007-1.

  Perform task only to the extent which is consistent with the hardware
  design activity of this phase.

This qualifier was identified for MIL-STD-785B Task 208 using this
rule.
tailor-r-qual-rule-1-208:
    if program-phase = concept or
       program-phase = demo-valid
    then qualifier(std_785b-208) = q00001-1 and
         qualifier(std_785b-208) = q00007-1.

  Task is required only if critical items are identified by the FMECA.

The user confirmed to add Task 204 to MIL-STD-785B
  to satisfy a linkage to MIL-STD-785B Task 205.
```

The user overrode the system by adding Task 205 to MIL-STD-785B.
The default rank of 9 was assigned for this task.

The user overrode the system by adding Task 206 to MIL-STD-785B.
The default rank of 9 was assigned for this task.

The user overrode the system by deleting Task 202 from MIL-STD-785B.

The user overrode the system by deleting Task 103 from MIL-STD-785B.

End of CATSOP Audit Trail.

APPENDIX B

R/M/L CATSOP USERS GUIDE

APPENDIX B

R/M/L CATSOP USERS GUIDE

INTRODUCTION

The purpose of CATSOP is to assist in the process of tailoring the following Military Standards:

MIL-STD-470A Maintainability Program for Systems and Equipment

MIL-STD-1388-1A, Logistics Support Analysis

MIL-STD-785B Reliability Program for Systems and Equipment Development and Production.

CATSOP is an expert system that takes into account program characteristics such as system requirements, maintenance concepts, mission needs, acquisition phase, and funding levels to determine the scope and makeup of each task within these standards. The user provides these inputs and then the system determines the tailored results. The user may edit these inputs and the system will retailor the MIL-STDS. The user may override the system by adding or deleting tasks to/from the tailored results. The CATSOP expert system uses the M.1 expert system shell by Teknowledge Inc.

USING R/M/L CATSOP

Start Up Process The procedure for initiating CATSOP from a cold Zenith 248 is to power up the computer and run the CATSOP batch file which will invoke M.1 and the R\M\L CATSOP program (note: CATSOP requires all 640k memory therefore no other programs should be loaded concurrently). The command sequence is as follows:

```
>cd \catsop
>catsop
```

Special Features The CATSOP screen format is shown below. The items listed across the top of the screen identify M.1 pull down menus. The items listed at the bottom identify several function keys that can be utilized during CATSOP consultations.

```
EXECUTION     KNOWLEDGE BASE     CACHE     LOGGING/AUDIT

CATSOP>




F1 CATSOP   F2 SCROLL   F4 EXPLAIN   F5 CONTINUE   F10 MENU
```

Pull Down Menus The menus are activated via the F10 function key. They are provided as an alternate means of interacting with M.1. Once activated, the up and down arrow keys are used to move within a menu, the left and right arrow keys move between menus, and the return key is used to make a selection.

CATSOP Help Help is available to the CATSOP user via the F1 CATSOP function key or by typing the key word 'catsop' at any prompt. This will interrupt the conslutation and take the user to the CATSOP Help Menu which provides several help categories. Subsequent menus are used to identify the help option and then the help text is displayed to the screen. Some of the topics covered by the help are; use of function keys, explanations, audit trail and overriding the tailored recommendation.

Explanations Explanation screens are available for all requested user inputs. The explanations can be accessed using the F4 'EXPLAIN' function key or by typing the key word explain at any prompt. The explanation provides information to help the user respond properly.

Audit Trail An audit trail is maintained throughout each consultation and is available for inspection at any time. To access the audit trail use the F10 MENUS function key and choose 'CATSOP AUDIT TRAIL' from the LOGGING/AUDIT menu. The audit trail will identity the answers given for the tailoring questions and will step through all the tailoring decisions made by the system. It will also show the actions of the user in overriding the system. The audit trail is saved to a file whenever the tailored results are saved.

Scrolling The F2 SCROLL function key allows the user to scroll back the screen output.

User Inputs

While using CATSOP four types of user input may be required. The system validates all user responses and reprompts when an invalid answer is given. The system will also accept "unknown" or "u" if an answer is not known.

Menu Selection Format Each menu has enumerated choices and the system expects a numeric response. Multiple answers must be separated with a comma.

YES/NO Format Some question require yes or no. The system also accepts y for yes and n for no.

Quantity Format Some question ask for a quantity and the system expects a numeric response

Free Format The system will request a program name, the date, and a file identifier. The system only tries to verify that a single word or a quoted phrase was entered. For example, the user could type any of the following in response to todays date:

8/18
Aug18
"August 18"

CATSOP OPTION MENU

CATSOP can be used to tailor a new program or revise a previously tailored one. The user may stop a consultation prior to answering all the question, by responding with stop from any prompt, and then resume it later. These top-level control options are identified in the CATSOP Option Menu which is as follows:

CATSOP OPTION MENU

0. EXIT CATSOP
1. Tailor New Program
2. Revise Previously Tailored Program
3. Resume a Previous Session

Enter Desired Option:

When tailoring a new program, the system will ask a series of questions and then perform the tailoring. If resuming a previous session, the system will begin the questioning where it previously left off and proceed on as before. Once the initial tailoring is complete, the User Options Menu appears. If revising a previously tailored program the system goes directly to the User Options Menu.

USER OPTIONS MENU

Once a program has been tailored the User Options Menu appears. This menu provides several options that allow the user to review the tailored results and make changes until he is satisfied with the system output. The user can edit his answers to the tailoring questions and let CATSOP retailor the program or he can directly override the results by adding or deleting tasks. The tailoring inquiries feature allows the user to ask about the tailoring process. When satisfied the results can be saved and the program exited. The User Options Menu is shown below.

USER OPTIONS MENU

0. Exit User Options
1. Display Results
2. Edit Answers
3. Override Tailored Results
4. Tailoring Inquiries
5. Save Results

Enter Desired Option:

SYSTEM OUTPUT

The tailored results are displayed by choosing 'Display Results' from the User Options Menu. The user may display any one or any combination of the R/M/L MIL-STD recommended tasks. He can also view a report summarizing the support data needed from the contracting authority in support of each task. Each of these reports is logged to a file when the 'Save Results' option is chosen from the User Options Menu.

The audit trail is also logged to a file when the 'Save Results' option is chosen. It can be displayed at any time using the audit trail command from the LOGGING/AUDIT menu. The audit trail is a record of all decisions made during the tailoring process. It summarizes the logic used to base each decision. This information is most helpful when analysing the system performance and is a valuable tool during the knowledge base modification process.

Another valuable output of the system is the impact of deletion report that is displayed when the user wants to delete tasks from the recommended list. This report summarizes how the deletion will impact other tasks and what risks will be incurred as a result.

Any part of a CATSOP consultation can be logged to a disk file or to the printer using the log commands from the LOGGING/AUDIT pull down menu. Hardcopies of the logged files can be generated using the DOS print command.

KNOWLEDGE BASE UPDATES

CATSOP was developed using M.1 which is a commercial knowledge system shell/tool. M.1 provides an easy to use environment for developing and packaging knowledge base applications. The M.1 software is accompanied with complete and thorough documentation which describes the tool and its features. It also provides several sample knowledge systems that are used to introduce the tool to new users. It is highly recommended that anyone who wishes to modify the CATSOP program first review this M.1 documentation.

Upon reviewing the M.1 documentation, the user must then review all the CATSOP documentation. The CATSOP Software Product Specification includes the Software Top-Level Design Document, Software Detailed Design Document, the Data Base Design Document and the source code listings. These documents describe the software flow and knowledge base partitions.

R/M/L CATSOP was developed as a prototype with the expectation that additional effort will be directed toward completing the knowledge bases. The following steps outline the basic procedure. It is recommended that additions be made in small increments.

1.) Identify the changes Presently, only tasks applicable to the concept exploration phase are handled. It is assumed that all remaining R/M/L tasks will be added along with rules to tailor them. These tasks can be added by first removing the comment delimeters from records in task.kb and then adding the rules relative to those tasks. Additional questions may be required to support the new rules. New questions should be put in question.kb. The tailoring-questions-asked rule in catsop.kb will also need to be modified to invoke the new questions. There are several categories of tailoring rules and they are partitioned into several knowledge bases. Refer to the Data Base Design Document for a description of the content in each of the 20 CATSOP knowledge base files. Refer to the source code listings to identify the proper places within these files to make the identified changes.

2.) Edit the source file The source files are refered to as knowledge bases and are found in the \catsop\source directory. The knowledge bases are created and modified using any standard ascii text editor. Prior to making any change you should backup the file so it can be restored if necessary. The Data Base Design Document details specific syntax where applicable, otherwise, refer to the M.1 manuals.

3.) Create a fast-load file Knowledge bases are not compiled, but instead are loaded into M.1 as data. M.1 checks for syntax errors as source files are read in. Once a knowledge base loads without errors a "fast-load" file is made. Fast-load files are found in the \catsop directory. The following example is provided using tailor11 knowledge base:

```
>cd \catsop
>m1kb tailor11
```

The \catsop\source\tailor11.kb file will be loaded. You will see the CATSOP banner and then the M.1 window. All errors will be identified in the window. When loading is complete the M.1 prompt will appear. If no errors/warnings occurr then save the kb in fast-load format and then exit as follows:

```
M.1> fsave tailor11.fkb

M.1> <alt>q
```

```
=CONFIRM=============================================
|| Exit to DOS? [y/n]  y                            ||
=========================================== ESC to Cancel=
```

If errors are identified they should be corrected before continuing. Leave M.1 without saving and edit the file as necessary.

4.) **Test the change** Once a fast-load file has been generated the changes can be tested by running examples and evaluating the results. See the M.1 manuals for descriptions of M.1 utilities which can be used to aid this testing process.

APPENDIX C

R/M/L CATSOP USER QUESTIONS AND EXPLAIN SCREENS

APPENDIX C

R/M/L CATSOP USER QUESTIONS AND EXPLAIN SCREENS

This appendix contains a listing of all the user questions contained in R/M/L CATSOP and the associated Explain Screens. Each question is presented followed by its accompanying Explain Screen.

PROGRAM PHASE QUESTION

Identify the program phase for the contract for which the specifications are being tailored.

1. Pre-concept Exploration
2. Concept Exploration
3. Demonstration/Validation
4. Full Scale Development
5. Production

PROGRAM PHASE

Phase	Definition
Pre-Concept Exploration	The planning period which precedes the contract award for Concept Exploration phase tasks.
Concept Exploration	The identification and exploration of alternative solutions or solution concepts to satisfy a validated need.
Demonstration and Validation	The period when selected candidate solutions are refined through extensive study and analyses; hardware development, if appropriate; test; and evaluations.
Full-Scale Development	The period when the system and the principal items necessary for its support are designed, fabricated tested and evaluated.
Production and Deployment	The period from production approval until the last system is delivered and accepted.

STANDARDS TO CONSIDER QUESTION

Which standards do you wish to consider during this session?

1. 1388-1a - Logistics Support Analysis
2. 470a - Maintainability
3. 785b - Reliability
4. All Three Standards

STANDARDS TO CONSIDER

Identify the MIL-Standards you wish to consider in this session. Multiple answers must be separated by a comma. If a standard is not being considered the Tailoring Recommendation Report and Contracting Agency Supplied Data Report regarding that standard will identify only those tasks needed to support the Standards you select here.

CONTRACT OBJECTIVE QUESTION

Select one of the following which best describes the overall objective of this contract.

1. Develop Possible Concepts to Meet Statement of Need
2. Provide Basis for Selecting System which Satisfies Mission Need and Warrants Further Development
3. Verify Conceptual Results and Define System Sufficiently for Detailed Design
4. Detailed Design/Development and Qualification
5. Produce and Deploy

OVERALL CONTRACT OBJECTIVE

The purpose of this question is to determine the top level objective of the contract for which you are tailoring the specifications. The alternate objectives which are listed to select from parallel the typical objectives for the established program phases. Your answer to this screen gives you the opportunity to indicate an objective which is different than that normally expected for the identified program phase if that is the case.

SUPPORT DEVELOPMENT QUESTION

Select one of the following which best describes the objective of this contract so far as development of support characteristics are concerned.

1. No Consideration
2. Make-up as Possible Previous Shortcomings
3. Consistent with Equipment Development

CONTRACT OBJECTIVE REGARDING SUPPORT

The answer to this question describes the overall objective of the contract so far as Reliability, Maintainability, and LSA are concerned. The degree of specific emphasis to be placed in each of the individual areas will be interpreted from the answer to the 'Budget' question.

Alternative	Definition
No Consideration	Objective is to establish some form of good basic Reliability and Maintainability features in the hardware design with no effort specifically directed toward LSA.
Make-up as Possible Previous Shortcomings	The information from previous phases (if applicable is incomplete and/or no longer applicable. The current objective is to complete those tasks to the extent necessary/appropriate/possible and then provide the data consistent with the current phase.
Consistent with Equipment Development	Objective is to have an integrated R/M/L effort consistent with the intent of the three MIL-Standards according to the current program phase and/or status of the hardware development.

HARDWARE LEVEL QUESTION

The hardware level being contracted for in this procurement is:

1. A Weapon System
2. A System/Subsystem
3. A First Level Replaceable Unit
   (LRU, WRA, LRA)
4. A Subassembly or Subassemblies of a First Level Replaceable Unit
   (SRU, SRA)

HARDWARE LEVEL

The answer to this question defines the top level of hardware involved in the current contract. If more than one answer describes this product, use the first answer in the list which applies. Specifically, if the hardware is one 'First Level Replaceable Unit' which also constitutes a 'System/ Subsystem', the appropriate answer would be 'System/Subsystem'.

MAINTENANCE CONCEPT QUESTION

Is a discard-at-failure maintenance concept expected for the contract item?

NON-REPAIRABLE-ITEM

If it has been determined (or it is expected) that the total hardware product of this contract is not to be repaired upon failure, answer 'yes'.

EQUIPMENT DESCRIPTION QUESTION

What best describes the hardware which is the subject of this contract?

1. Existing Major Assemblies
2. Simple Modification
3. Major Modification
4. New Design - Existing State of the Art
5. New Design - New Materials/Processes
6. New Design - Advanced State of the Art

EQUIPMENT DESCRIPTION

The answer provided for this question identifies the degree of uniqueness of the expected program and the ability of the Reliability, Maintainability, and LSA efforts to impact the design.

Option	Definition
Existing Major Assemblies	Program is to use existing hardware Assemblies/Subassemblies as they exist without modification.
Simple Modification	Top level hardware product of the contract is to be made up primarily of existing hardware. Overall, the design effort is less than 15 percent of an equivalent new design.
Major Modification	Top level hardware product of the contract is to use a significant amount of existing hardware. Overall, the design effort is less than 40 percent of an equivalent new design.
New Design - Existing State of the Art	Program is a new design effort. No new materials or processes are to be developed. Some parts/materials may not have been used on previous programs.
New Design - New Materials/ Processes	Program is a new design effort. Key to the design is the development of some new materials/processes. This development is not a significant departure from existing similar items.
New Design - Advanced State of the Art	Program is a new design effort. Achievement of requirements requires some significant new developments which are beyond the current state of the art.

HARDWARE APPLICATION QUESTION

What best describes the application of the hardware which is the subject of this contract?

1. Existing Application
2. Modified Application
3. New Application

APPLICATION DESCRIPTION

The answer to this question describes the planned application for the previously described hardware. The answer provided identifies the amount of existing support data which may be available from previous programs.

Option	Definition
Existing Application	The weapon system or other ultimate use of the contract hardware is already deployed by the contracting service. The hardware for this contract may not necessarily have been previously used in this application, however.
Modified Application	The weapon system or other ultimate use of the contract hardware is in use by the contracting service or someone else. The program involves some change in that deployment, however. This change may be moving to a different service or to a different application in the same service.
New Application	The weapon system or other ultimate use of the contract hardware is a new design and has not been put to use prior to this program.

PRODUCTION QUANTITY THIS CONTRACT QUESTION

What is the total number of types of contract 'end items' planned to be produced under this contract?

What is the average number of each type of contract 'end item' planned to be produced under this contract?

PLANNED PRODUCTION QUANTITY - THIS CONTRACT

The answer provided for this question notes the quantity of hardware items to be produced under the contract for which tailoring is being performed.

'Number of Types' refers to the quantity of unique 'Top-Level' part numbers expected to be defined under the current contract.

'Average Number of Each Type' is the average quantity of each unique 'Top-Level' item expected to be built under the current contract.

Please note that the 'Top-Level' for a specific contract is the highest hardware indenture level defined.

TOTAL ULTIMATE PRODUCTION QUANTITY QUESTION

What is the total number of types of contract 'end items' expected to be fielded?

What is the average number of each type of contract 'end item' expected to be fielded?

PLANNED PRODUCTION QUANTITY - TOTAL ULTIMATE PROGRAM

The answer provided for this question notes the ultimate planned quantity of hardware items to be fielded under the program this contract is a part.

'Number of Types' refers to the quantity of unique 'Top-Level' part numbers expected to be defined under the current contract which will ultimately be fielded.

'Average Number of Each Type' is the average quantity of each unique 'Top-Level' item which is ultimately expected to be built for the program the current contract is a part.

Please note that the 'Top-Level' for a specific contract is the highest hardware indenture level defined.

BUDGET QUESTIONS

Logistic Support Analysis (MIL-STD-1388-1A)
Expected budget for program is:

1. Normal
2. Limited
3. Very Limited
4. Unknown

Maintainability (MIL-STD-470A)
Expected budget for program is:

1. Normal
2. Limited
3. Very Limited
4. Unknown

Reliability (MIL-STD-785B)
Expected budget for program is:

1. Normal
2. Limited
3. Very Limited
4. Unknown

BUDGET DESCRIPTION

Descriptor	Definition	Expected Program Results
Normal	Cost analyses indicates based on past experience the total budget will be adequate to do a nominal risk program.	Procuring agency wants a 'full' or 'typical' program which meets objectives, minimal risks, and is cost effective but not constrained due to budget. Tasks are selected based on all other considerations.
Limited	60 - 90 % of a 'Normal' budget.	Procuring agency wants less than a 'full' program. Tasks that are considered less than mandatory to meet objectives are not specified. Reasonable backup, justification and tradeoffs are still required.
Very Limited	Less than 59 % of a 'normal' budget.	Procuring agency expects minimal emphasis. Perform only mandatory tasks with little or no trades, backup, or other justification.

CONTRACT SCHEDULE QUESTION

The projected overall schedule for this contract is considered by program analysts to be:

1. Normal
2. Short
3. Very Short

PROGRAM SCHEDULE

This question relates to the overall schedule of the contract for which the tailoring is being done. The answer selected should be based on engineering analysis of the total contract task. Given their experience with similar past programs, how does the schedule for this program relate?

Option	Definition
Normal	Considering the analysis described above, the overall schedule planned for this contract is adequate with nominal risk.
Short	The overall schedule is considered to be somewhat less than adequate. Risks of completion on time are considerable. (Comparable schedule range is 70 - 90 percent of Normal.)
Very Short	Meeting the overall schedule will require major management emphasis. There is little or no time for trade studies. Manpower will be applied much heavier than normal and work will possibly be around the clock. (Comparable schedule range is less than 70 percent of Normal.)

EQUIPMENT UTILIZATION QUESTION

The contracted equipment will be utilized in:

1. Ground Support/Test
2. Ground Primary Equipment
3. Spacecraft Manned
4. Spacecraft Unmanned
5. Airborne Inhabited
6. Airborne Uninhabited
7. Missile Launch
8. Missile Free Flight
9. Manpack

EQUIPMENT UTILIZATION

This question is requesting the planned application of the hardware being developed and/or procured under the contract for which the standards are being tailored. If the specific application of this hardware is other than one of those listed, please identify the one which mostly represents the application.

If the hardware is being developed for more than one application, select the one application which has the greatest environmental stresses.

CATASTROPHIC FAILURE CONSIDERATIONS QUESTION

Catastrophic failure of the equipment will result in:

1. Loss of Life
2. Mission Abort
3. Loss of Function/Degradation of Mission
4. Loss of Redundancy/No Loss of Function
5. No Detectable Effect on Any Required Function or Overall Mission Success

CATASTROPHIC FAILURE CONSIDERATIONS

The answer to this question describes the seriousness of an equipment failure in the hardware being developed/produced. A catastrophic failure is the state wherein the subject hardware ceases to provide one or more of its intended functions. Your answer should reflect the most serious impact of a catastrophic failure if one were to occur during the use of the hardware.

ESTABLISHED SPECIFICATIONS QUESTION

Which of the following specifications have been established for the equipment which is the subject of this contract?

1. Reliability Specification
2. Maintainability Specification (including Diagnostics)
3. Overall Logistics Concepts (ie. Deployment and Maintenance Plans)
4. None

ESTABLISHED SPECIFICATIONS

The answer to this question determines the applicability or need for those LSA tasks which are directed toward determining specification information (requirements) and support concepts. Specifications refer to the quantitative and qualitative reliability and maintainability parameters which must be met by the subject equipment. Overall Logistics Concepts define how the equipment is to be deployed and maintained.

An answer that an item has been established means that the information has been determined and no effort should be spent under this contract for further development of the information.

Generally these specifications and Logistics concepts are all derived in the same process. Thus the answer to this question is usually either all three or none of them.

DESIGN DIFFICULTY QUESTIONS

Indicate the expected design difficulty in the attainment of the established Reliability specification requirements.

1. Will Require Significant Emphasis
2. Will Require a Nominal Amount of Concentration
3. Can be Achieved with Simply Good Design Practices

Indicate the expected design difficulty in the attainment of the established Maintainability specification requirements.

1. Will Require Significant Emphasis
2. Will Require a Nominal Amount of Concentration
3. Can be Achieved with Simply Good Design Practices

DESIGN DIFFICULTY

This question is asked to determine the expected degree of difficulty to be experienced in obtaining the desired specification requirements.

Significant Emphasis	Achievement of the specification requirements will take a concerted effort in terms of research, creative thinking, management focus, and alternative evaluation. Comparable values on comparable systems have not been previously achieved in an operational environment.
Nominal Concentration	Specification requirements are considered somewhat typical for equivalent military equipment. Comparable specification values have been obtained on other equivalent systems, but not without specific program tasks designed for their achievement.
Good Design Practices	Specification values can be achieved without special attention, i.e. they will come essentially as a by-product of the design. Standard design practices related to packaging, component derating, etc. will be sufficient to meet the requirements.

PREVIOUSLY COMPLETED EFFORT QUESTION

Select the tasks which have been previously completed (finished) for this hardware and the results are available to this contract.

PREVIOUSLY COMPLETED

Previously completed tasks are those which meet all of the following criteria:

a. The effort performed is applicable to the current hardware.
b. The data (information) from this effort is complete, acceptable, and available to this contract.
c. There will be no need to update or revise the data during the conduct of this contract.

PARTIALLY COMPLETED EFFORT QUESTIONS

Select the tasks which have been previously performed for this hardware but may still require completion or update. Data from the previous effort must be available to this contract.

PREVIOUSLY STARTED

Previously started tasks (those still requiring completion or update) are define by the following criteria:

a. The effort performed is applicable to the current hardware.
b. The data (information) from this effort is complete, acceptable, and available to this contract.
c. A need to update or revise the data during the conduct of this contract is expected.

APPENDIX D

R/M/L CATSOP TAILORING RULES

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R/M/L CATSOP TAILORING RULES

This Appendix contains a description of the tailoring rules and information currently contained in R/M/L CATSOP. This is presented in the following five major categories.

I. Task Deletion and Note Application Rules

The following rules are used in R/M/L CATSOP to delete unwanted tasks and apply appropriate task qualifying notes. The rules are presented on the left side of each matrix. The task applicability of each rule is shown by an X under each applicable task.

MIL-STD-1388 TASK DELETION RULES (Page 1 of 3)

DELETE TASK FROM RECOMMENDED LIST UNDER THE FOLLOWING CONDITIONS	L101 .2.1	L101 .2.2	L102 .2.1	L102 2.2	L103 .2.1	L103 .2.2	L103 .2.3	L103 .2.4	L201 .2.1	L201 .2.2	L201 .2.3	L201 .2.4	L202 .2.1	L202 .2.2	L202 .2.3	L202 .2.4
ALL CONDITIONS. (TASK IS NEVER RECOMMENDED)	X	X		X												
IF RELIABILITY OR MAINTAINABILITY SPECIFICTIONS OR LOGISTICS CONCEPTS HAVE BEEN ESTABLISHED OR IF ITEM IS EXPECTED TO BE DISCARED AT FAILURE.									X	X	X		X	X	X	
IF HARDWARE LEVEL IS A FIRST LEVEL REPLACEABLE UNIT (LRU).											X		X	X	X	
IF HARDWARE LEVEL IS A SUBASSEMBLY OF A FIRST LEVEL REPLACEABLE UNIT (SRU).									X	X	X		X	X	X	
IF PROGRAM PHASE IS PRE-CONCEPT AND HARDWARE LEVEL IS NOT A WEAPON SYSTEM.									X	X	X					
IF HARDWARE LEVEL IS A LRU AND NOT A NEW DESIGN WITH NEW MATERIALS OR ADVANCED STATE OF ART, OR A NEW APPLICATION OR PROGRAM PHASE IS NOT DEM VAL OR FSD.									X	X						
IF LSA OBJECTIVE IS NOT TO MAKE UP PREVIOUS SHORTCOMINGS AND HARDWARE IS EXISTING OR A SIMPLE MODIFICATION IN AN EXISTING APPLICATION.									X	X	X		X	X	X	
IF LSA IS TO HAVE NO CONSIDERATION.			X		X	X	X	X								
IF LSA BUDGET IS VERY LIMITED OR PROGRAM SCHEDULE IS VERY SHORT.																X
IF THERE ARE SIX OR LESS OTHER LSA TASKS.			X		X	X										
IF THERE ARE EIGHT OR LESS OTHER LSA TASKS AND THE BUDGET IS VERY LIMITED.			X		X	X	X	X								
IF TASK L201.2.1 HAS BEEN COMPLETED									X							
IF TASK L201.2.2 HAS BEEN COMPLETED										X						
IF TASK L201.2.3 HAS BEEN COMPLETED											X					
IF TASK L201 HAS BEEN COMPLETED									X	X	X	X				
IF TASK L202 HAS BEEN COMPLETED													X	X	X	X
IF ONE OR MORE OF THE FOLLOWING TASKS ARE NOT SELECTED -																
L201.2.1, 2, OR 3 (RULE DOES NOT APPLY IF TASK 201 OR ANY SUB TASK IS NOTED AS PARTIALLY DONE.)												X				
L202.2.1, 2, OR 3																X

MIL-STD-1388 TASK DELETION RULES (Page 2 of 3)

DELETE TASK FROM RECOMMENDED LIST UNDER THE FOLLOWING CONDITIONS	L203 .2.1	.2.2	.2.3	.2.4	.2.5	.2.6	.2.7	.2.8	L204 .2.1	.2.2	.2.3	L205 .2.1	.2.2	.2.3	.2.4	.2.5
ALL CONDITIONS. (TASK IS NEVER RECOMMENDED)																X
IF RELIABILITY OR MAINTAINABILITY SPECIFICTIONS OR LOGISTICS CONCEPTS HAVE BEEN ESTABLISHED OR IF ITEM IS EXPECTED TO BE DISCARED AT FAILURE.	X	X	X	X	X	X						X	X	X		
IF HARDWARE LEVEL IS A FIRST LEVEL REPLACEABLE UNIT (LRU).												X	X			
IF HARDWARE LEVEL IS A SUBASSEMBLY OF A FIRST LEVEL REPLACEABLE UNIT (SRU).	X	X	X	X	X	X			X			X	X	X		
IF PROGRAM PHASE IS PRE-CONCEPT AND HARDWARE LEVEL IS NOT A WEAPON SYSTEM.	X	X	X	X	X	X										
IF HARDWARE LEVEL IS A LRU AND NOT A NEW ADVANCED STATE OF THE ART AND ULTIMATE FIELDED QTY IS EXPECTED TO BE LESS THAN 100.	X	X	X	X	X	X										
IF RELIABILITY AND MAINTAINABILITY REQUIREMENTS CAN BE ACHIEVED WITH SIMPLY GOOD DESIGN PRACTICES.									X							
IF HARDWARE IS EXISTING, A SIMPLE MODIFICATION, OR NEW DESIGN OF EXISTING STATE OF THE ART.									X							
IF LSA OBJECTIVE IS NOT TO MAKE UP PREVIOUS SHORTCOMINGS AND HARDWARE IS EXISTING OR A SIMPLE MODIFICATION IN AN EXISTING APPLICATION.	X	X	X	X	X	X			X			X	X	X		
IF LSA BUDGET IS VERY LIMITED OR PROGRAM SCHEDULE IS VERY SHORT.								X			X					
IF TASK L203.2.1 HAS BEEN COMPLETED	X															
IF TASK L203.2.2 HAS BEEN COMPLETED		X														
IF TASK L203.2.3 HAS BEEN COMPLETED			X													
IF TASK L203.2.4 HAS BEEN COMPLETED				X												
IF TASK L203.2.5 HAS BEEN COMPLETED					X											
IF TASK L203.2.6 HAS BEEN COMPLETED						X										
IF TASK L203.2.8 HAS BEEN COMPLETED								X								
IF TASK L203 HAS BEEN COMPLETED	X	X	X	X	X	X		X								
IF TASK L204 HAS BEEN COMPLETED									X		X					
IF TASK L205 HAS BEEN COMPLETED												X	X	X	X	
IF ONE OR MORE OF THE FOLLOWING TASKS ARE NOT SELECTED -																
L203.2.2, 2, 3, 4, 5, 6, OR 7								X								
L204.2.1 OR 2											X					

MIL-STD-1388 TASK DELETION RULES (Page 3 of 3)

DELETE TASK FROM RECOMMENDED LIST UNDER THE FOLLOWING CONDITIONS	L301 .2.1	L301 .2.2	L301 .2.3	L301 .2.4	L301 .2.5	L301 .2.6	L302 .2.1	L302 .2.2	L302 .2.3	L303 .2.4	L303 .2.5	L303 .2.1	L303 .2.2	L303 .2.3	L303 .2.4	LS01 .2.1
IF RELIABILITY OR MAINTAINABILITY SPECIFICTIONS OR LOGISTICS CONCEPTS HAVE BEEN ESTABLISHED OR IF ITEM IS EXPECTED TO BE DISCARED AT FAILURE.							X		X							
IF HARDWARE LEVEL IS A FIRST LEVEL REPLACEABLE UNIT (LRU).							X		X							X
IF HARDWARE LEVEL IS A SUBASSEMBLY OF A FIRST LEVEL REPLACEABLE UNIT (SRU).							X		X							X
IF LSA OBJECTIVE IS NOT TO MAKE UP PREVIOUS SHORTCOMINGS AND HARDWARE IS EXISTING OR A SIMPLE MODIFICATION IN AN EXISTING APPLICATION OR A EXISTING DESIGN IN A MODIFIED APPLICATION.		X														
IF LSA OBJECTIVE IS NOT TO MAKE UP PREVIOUS SHORTCOMINGS AND HARDWARE IS EXISTING OR A SIMPLE MODIFICATION IN AN EXISTING APPLICATION.	X			X	X		X		X				X	X		X
IF LSA IS TO HAVE NO CONSIDERATION.	X	X		X	X		X		X				X	X		X
IF LSA BUDGET IS VERY LIMITED OR PROGRAM SCHEDULE IS VERY SHORT.			X		X						X		X	X		
IF TASK L301 HAS BEEN COMPLETED	X	X	X	X	X											
IF TASK L302 HAS BEEN COMPLETED							X		X		X					
IF TASK L303 HAS BEEN COMPLETED												X	X	X	X	
IF TASK LS01 HAS BEEN COMPLETED																X
IF ONE OR MORE OF THE FOLLOWING TASKS ARE NOT SELECTED -																
L301.1 OR 2			X													
L302.2.1, 2, 3, OR 4											X					
L303.2.2 OR 3												X			X	

MIL-STD-1388 NOTE APPLICATION RULES

APPLY INDICATED NOTE IF THE TASK IS RECOMMENDED AND THE FOLLOWING CONDITION EXISTS.	L201 .2.1	.2.2	.2.3	.2.4	L202 .2.1	.2.2	.2.3	.2.4
IN ALL CASES	12	12	12	12	12	12	12	12
IF LSA BUDGET IS LIMITED OR THE SCHEDULE IS SHORT.								13
IF LSA BUDGET IS VERY LIMITED OR THE SCHEDULE IS VERY SHORT.								
IF THE PROGRAM PHASE IS PRE-CONCEPT, CONCEPT EXPLORATION, OR DEM VAL.								

APPLY INDICATED NOTE IF THE TASK IS RECOMMENDED AND THE FOLLOWING CONDITION EXISTS.	L203 .2.1	.2.2	.2.3	.2.4	.2.5	.2.6	.2.7	.2.8	L204 .2.1	.2.2	.2.3	L205 .2.1	.2.2	.2.3	.2.4	.2.5
IF PROGRAM PHASE IS PRE-CONCEPT OR CONCEPT EXPLORATION.	12	12	12	12	12	12	12	12	12	12	12					
IF LSA BUDGET IS LIMITED OR THE SCHEDULE IS SHORT.								13			13					

APPLY INDICATED NOTE IF THE TASK IS RECOMMENDED AND THE FOLLOWING CONDITION EXISTS.	L301 .2.1	.2.2	.2.3	.2.4	.2.5	.2.6	L302 .2.1	.2.2	.2.3	.2.4	.2.5	L303 .2.1	.2.2	.2.3	.2.4	L501 .2.1
IN ALL CASES															32	
IF PROGRAM PHASE IS PRE-CONCEPT OR CONCEPT EXPLORATION.	12	12	12	12	12	12	12	12	12	12	12					
IF LSA BUDGET IS LIMITED OR THE SCHEDULE IS SHORT.			13		13						13					13
IF LSA BUDGET IS VERY LIMITED OR THE SCHEDULE IS VERY SHORT.																13
IF THE PROGRAM PHASE IS PRE-CONCEPT, CONCEPT EXPLORATION, OR DEM VAL.	28	28		29	29		30		30				31	31		

MIL-STD-785 TASK DELETION RULES

DELETE TASK FROM RECOMMENDED LIST UNDER THE FOLLOWING CONDITIONS	R101	R102	R103	R104	R105	R202	R203	R204	R207. 1	R207. 2	R208
IF PROGRAM PHASE IS PRE-CONCEPT						X	X	X	X	X	X
IF PROGRAM PHASE IS PRODUCTION						X	X	X		X	X
IF HARDWARE LEVEL IS A SUB-ASSEMBLY OF A FIRST LEVEL REPLACABLE ASSEMBLY.						X					
IF HARDWARE LEVEL IS A SUB-ASSEMBLY OF A FIRST LEVEL REPLACABLE ASSEMBLY AND CATASTROPHIC FAILURE WILL HAVE NO DETECTABLE EFFECT.								X			
IF THE RELIABILITY BUDGET IS VERY LIMITED AND RELIABILITY WILL NOT REQUIRE A SIGNIFICANT EMPHASIS.									X	X	
IF EXISTING ASSEMBLIES IN AN EXISTING APPLICATION.						X	X	X	X	X	
IF A SIMPLE MODIFICATION IN AN EXISTING APPLICATION.										X	
IF A SIMPLE MODIFICATION IN AN EXISTING APPLICATION AND RELIABILITY WILL NOT REQUIRE A SIGNIFICANT EMPHASIS.									X		
IF EXISTING ASSEMBLIES IN A MODIFIED OR NEW APPLICATION.						X			X	X	
IF A SIMPLE MODIFICATION IN A MODIFIED OR NEW APPLICATION.									X	X	
IF TASK R201 HAS BEEN COMPLETED						X					
IF TASK R202 HAS BEEN COMPLETED							X				
IF TASK R204 HAS BEEN COMPLETED								X			
IF TASK R207 HAS BEEN COMPLETED									X	X	
IF TASK R208 HAS BEEN COMPLETED											X
IF THERE ARE THREE OR LESS SEPERATE OTHER RELIABILITY TASKS.	X										
IF THERE ARE FOUR OR LESS SEPERATE OTHER RELIABILITY TASKS AND BUDGET IS VERY LIMITED OR RELIABILITY REQUIREMENTS CAN BE MET WITH GOOD DESIGN PRACTICES.	X										
IF RELIABILITY REQUIREMENTS CAN BE MET WITH GOOD DESIGN PRACTICES.		X	X								
IF ONE OR MORE OF THE FOLLOWING TASKS ARE NOT SELECTED: R301, R302, R303, OR R304				X	X						

MIL-STD-785 NOTE APPLICATION RULES

APPLY INDICATED NOTE IF THE TASK IS RECOMMENDED AND THE FOLLOWING CONDITION EXISTS.	R102	R201	R202	R203	R204	R207. 1	R207. 2	R208
IN ALL CASES	9							
IF PROGRAM PHASE IS CONCEPT EXPLORATION OR DEM/VAL.			1	1	1 4	1 5	1	1 7
IF PROGRAM PHASE IS DEM/VAL BUT A CATASTROPHIC FAILURE WILL RESULT IN MORE THAN NO DETECTABLE EFFECT.		1						
IF PROGRAM PHASE IS FULL SCALE DEVELOPMENT.								7
IF PROGRAM PHASE IS PRODUCTION OR HARDWARE IS LEVEL IS NOT A SUBASSEMBLY OR BUDGET IS LIMITED OR HARDWARE IS NEITHER EXISTING OR THE RESULT OF A SIMPLE MODIFICATION.						5		
IF HARDWARE LEVEL IS A FIRST LEVEL REPLACABLE ASSEMBLY AND A CATASTROPHIC FAILURE WILL RESULT IN MORE THAN NO DETECTABLE EFFECT.			3					
IF HARDWARE LEVEL IS A SUB-ASSEMBLY OF A FIRST LEVEL REPLACABLE ASSEMBLY AND ATTAINMENT OF THE RELIABILITY SPECIFICATIONS WILL REQUIRE SIGNIFICANT EMPHASIS.						5		
IF EQUIPMENT IS EITHER A SIMPLE OR MAJOR MODIFICATION.			2					
IF EQUIPMENT IS AN EXISTING DESIGN USED IN A MODIFIED OR NEW APPLICATION OR A SIMPLE OR MAJOR MODIFICATION, AND A CATASTROPHIC FAILURE WILL RESULT IN MORE THAN NO DETECTABLE EFFECT.		2						
IF EQUIPMENT IS A MAJOR MODIFICATION.						6	6	
IF TASK IS NOTED AS BEING PARTIALLY COMPLETED.	0	0	0	0	0	0	0	0

MIL-STD-470 TASK DELETION RULES

DELETE TASK FROM RECOMMENDED LIST UNDER THE FOLLOWING CONDITIONS	M101	M102	M103	M201	M202	M203	M204	M205
IF PROGRAM PHASE IS PRE-CONCEPT.				X	X	X	X	X
IF PROGRAM PHASE IS PRODUCTION.							X	
IF THE CONTRACT ITEM IS EXPECTED TO BE DISCARDED AT FAILURE.				X	X	X	X	X
IF ITEM IS AN EXISTING DESIGN TO BE USED IN AN EXISTING APPLICATION.				X	X	X	X	X
IF TASK M201 HAS BEEN COMPLETED				X				
IF TASK M202 HAS BEEN COMPLETED					X			
IF TASK M204 HAS BEEN COMPLETED							X	
IF TASK M205 HAS BEEN COMPLETED								X
IF THERE ARE THREE OR LESS SEPERATE OTHER MAINTAINABILITY TASKS.	X							
IF THERE ARE FOUR OR LESS SEPERATE OTHER MAINTAINABILITY TASKS AND BUDGET IS VERY LIMITED OR MAINTAINABILITY REQUIREMENTS CAN BE MET WITH GOOD DESIGN PRACTICES.	X							
IF MAINTAINABILITY REQUIREMENTS CAN BE MET WITH GOOD DESIGN PRACTICES.		X	X					

MIL-STD-470 NOTE APPLICATION RULES

APPLY INDICATED NOTE IF THE TASK IS RECOMMENDED AND THE FOLLOWING CONDITION EXISTS.	M102	M201	M202	M203	M204	M205
IN ALL CASES	9					
IF PROGRAM PHASE IS CONCEPT EXPLORATION OR DEM/VAL.		1	1	1	1	1
					4	10
						11
IF EXISTING EQUIPMENT USED IN A MODIFIED OR NEW APPLICATION OR EQUIPMENT IS A SIMPLE OR MAJOR MODIFICATION.		2	2	2		3
IF TASK 205 IS NOTED AS BEING COMPLETED.						8

II. List of Qualifying Notes

The following notes are invoked as appropriate by tailoring rules described in the previous section of this Appendix. Notes are referenced by number in the rules which invoke them.

NOTE N00001 - Perform task only to the extent which is consistent with the hardware design activity of this phase.

NOTE N00002 - Perform only if expected modification to equipment or application will impact previous effort already performed and available.

NOTE N00003 - Perform task only if unit has (or will have) sub-tier design-to specifications.

NOTE N00004 - Perform FMECA at a functional level to support diagnostics development as early as practicable. The initial FMECA work may pertain to major functions only. Continue to expand the FMECA as detailed function are defined.

NOTE N00005 - Perform Parts Control Program in accordance with MIL-STD-965 Procedure X (I or II).

NOTE N00006 - Task performance should be consistent with previous task efforts and sufficient to meet requirements.

NOTE N00007 - Task is required only if critical items are identified by the FMECA.

NOTE N00008 - Perform task only as required to update previous effort based on new and/or additional design information and activity.

NOTE N00009 - Perform task to the extent that subcontractor and supplier activity can impact meeting specification requirements.

NOTE N00010 - Elements to be considered are to be selected from Paragraph 205.2.2 of MIL-STD-470 to correspond to elements specified in the controlling hardware specification.

NOTE N00011 - Allocations, modeling, trade studies, etc. referred to in MIL-STD-470, Task 205, are the same tasks as are also defined in other applicable maintainability and LSA work statements. Do not perform equivalent tasks under more than one work statement.

NOTE N00012 - SPECIAL NOTE TO THE CONTRACTING AUTHORITY: In this acquisition phase this task is normally performed by a organization dealing with concepts and requirements. The Contracting Authority should consider if it should be part of the hardware acquisition contract or performed by anther agency.

NOTE N00013 - Maximize effectiveness and limit effort expended in risk analysis and/or alternative evaluation by considering only the most influential factors and characteristics.

NOTE N00014 - Update previously obtained supportability factors if more detailed or revised information is available on the intended use of the equipment.

NOTE N00015 - Update previously developed quantitative data if more detailed or revised information is available on the intended use of the equipment.

NOTE N00016 - Incorporate the data on previously completed field visits as applicable to new reported information on supportability factors. Perform additional field visits to the extent necessary to complete previous filed visit activity.

NOTE N00017 - Update the use study report based on new or additional data available on the intended use of the system.

NOTE N00018 - (this number not used)

NOTE N00019 - Update previously developed task information to reflect the results of (and/or information learned from) design engineering/Logistics activities and testing. Also include as applicable impact of other revised LSA tasks and/or customer direction.

NOTE N00020 - (this number not used)

NOTE N00021 - Continue previous effort to identify existing equipment(s) useful for comparison to the new equipment (previous task 203.2.1).

NOTE N00022 - Finalize the selection of a Baseline Comparison System(s) (BCS) for developing requirements for the new equipment (previous task 203.2.2).

NOTE N00023 - Update, complete, and/or finalize the identification of comparative parameters to be considered from the Baseline Comparison System selected for this program (previous task 203.2.3).

NOTE N00024 - Update, complete, and/or finalize the identification of Baseline Comparison System qualitative supportability problems to be prevented on the new equipment to be developed (previous task 203.2.4).

NOTE N00025 - Complete the previously started effort to determine supportability, cost, and readiness drivers of the Baseline Comparison System(s) (previous task 203.2.5).

NOTE N00026 - Complete the previously started effort to identify drivers for the new equipment for which no comparative hardware has been identified. (Previous task 203.2.6).

NOTE N00027 - Update previous risk analyses based on new information developed from this contract.

NOTE N00028 - Identify and Document Functions only to the support levels consistent with the design and trade activities of this phase.

NOTE N00029 - Limit task analysis only to the functions identified in Task 301.2.2.

NOTE N00030 - Develop Support Concepts and Plans only to the detail and levels consistent with the design and trade activities of this phase.

NOTE N00031 - Perform trade-offs on subjects and to the depth consistent with the design and trade activities of this program phase.

NOTE N00032 - Perform trade-offs described in this task only if the subject matter is of concern and applicable to this development effort.

III. Task Importance Ranking Rules

The following formula and parameter values are used to compute importance ranking values for each task.

BASIC FORMULA AND DEFINITIONS

TRF = A x B x C ROUNDED UP TO THE NEAREST INTEGER

WHERE:

TRF = TASK RANKING FACTOR
1 -- MOST IMPORTANT
9 -- LEAST IMPORTANCE

A = HARDWARE DESIGN/APPLICATION FACTOR
15 -- MOST IMPORTANT
20 -- LEAST IMPORTANT

B = HARDWARE UTILIZATION FACTOR
.02 -- MOST IMPORTANT
.05 -- LEAST IMPORTANT

C = TASK IMPORTANCE FACTOR
1 -- MOST IMPORTANT
9 -- LEAST IMPORTANT

HARDWARE APPLICATION FACTOR

	HARDWARE APPLICATION FACTOR		
QUESTION	O7A EXISTING APPLICATION	O7B MODIFIED APPLICATION	O7C NEW APPLICAT
O6A EXISTING MAJOR ASSEMBLIES	20.0	19.0	18.0
O6B SIMPLE MODIFICATION	19.0	18.0	18.0
O6C MAJOR MODIFICATION	18.0	18.0	17.0
O6D NEW DESIGN - EXISTING STATE OF THE ART	17.0	17.0	16.0
O6E NEW DESIGN - NEW MATERIALS/PROCESSES	16.0	16.0	16.0
O6F NEW DESIGN - ADVANCED STATE OF THE ART	15.0	15.0	15.0

HARDWARE UTILIZATION FACTOR

LSA HARDWARE UTILIZATION FACTORS

QUESTION	ESTIMATED QUANTIT (09B)	RANK	ESTIMATED QUANTITY (09B)	RANK	ESTIMATED QUANTITY (09B)	RANK
14A GROUND SUPPORT/TEST	Q>25	0.025	25>Q>5	0.028	Q<5	0.032
14B GROUND PRIMARY EQUIPMENT	Q>25	0.025	25>Q>5	0.028	Q<5	0.032
14C SPACECRAFT MANNED	Q>10	0.020	10>Q>3	0.024	Q<3	0.028
14D SPACECRAFT UNMANNED	Q>10	0.020	10>Q>3	0.024	Q<3	0.028
14E AIRBORN INHABITED	Q>100	0.020	100>Q>10	0.024	Q<10	0.028
14F AIRBORN UNINHABITED	Q>100	0.020	100>Q>10	0.024	Q<10	0.028
14G MISSILE LAUNCH	Q>100	0.020	100>Q>10	0.024	Q<10	0.028
14H MISSILE FREE FLIGHT	Q>100	0.020	100>Q>10	0.024	Q<10	0.028
14I MANPACK	Q>5000	0.030	5K>Q>500	0.040	Q<500	0.045
14J MUNITIONS, WOODEN ROUND, ETC	Q>5000	0.030	5K>Q>500	0.040	Q<500	0.045

R AND M HARDWARE UTILIZATION FACTORS

QUESTION	15A LOSS LIFE	15B MISSION ABORT	15C LOSS FUNCTION	15D LOSS REDUND	15E NO EFFECT
14A GROUND SUPPORT/TEST	0.025	0.027	0.028	0.032	0.040
14B GROUND PRIMARY EQUIPMENT	0.025	0.027	0.028	0.032	0.040
14C SPACECRAFT MANNED	0.020	0.022	0.024	0.028	0.035
14D SPACECRAFT UNMANNED	0.020	0.022	0.024	0.028	0.035
14E AIRBORN INHABITED	0.020	0.022	0.024	0.028	0.035
14F AIRBORN UNINHABITED	0.020	0.022	0.024	0.028	0.035
14G MISSILE LAUNCH	0.020	0.022	0.024	0.028	0.040
14H MISSILE FREE FLIGHT	0.020	0.022	0.024	0.028	0.040
14I MANPACK	0.030	0.033	0.040	0.045	0.050
14J MUNITIONS, WOODEN ROUND, ETC	0.030	0.033	0.040	0.045	0.050

TASK IMPORTANCE FACTOR

LSA TASK	TASK IMPORTANCE FACTOR 03A NO CONSIDERATION	03C CONSISTENT	03B MAKE-UP
102 LSA PLAN	1.0	1.0	1.0
103 PROGRAM REVIEWS	1.0	1.0	1.0
201 USE STUDY	9.0	2.0	1.0
202 STANDARDIZATION	9.0	5.0	3.0
203 COMPARATIVE ANALYSIS	9.0	4.0	3.0
204 TECHNOLOGICAL OPPORTUNITIES	9.0	4.0	3.0
205 DESIGN FACTORS	6.0	1.0	1.0
301 FUNCTIONAL REQUIREMENTS IDENT	9.0	3.0	2.0
302 SUPPORT SYSTEM ALTERNATIVES	7.0	4.0	2.0
303 ALTERNATIVES AND TRADEOFFS	6.0	1.0	1.0
501 TEST, EVAL AND VERIFICATION	9.0	1.0	1.0

RELIABILITY TASK	16 F/I GOOD DESIGN PRACTICE	16 E/H NOMINAL EFFORT	16 D/G SIGNIFICANT EMPHASIS
101 RELIABILITY PROGRAM PLAN	1.0	1.0	1.0
102 SUPPLIER CONTROL	1.0	1.0	1.0
103 REVIEWS	1.0	1.0	1.0
104 FRACAS	1.0	1.0	1.0
105 FAILURE REVIEW BOARD	1.0	1.0	1.0
201 MODELING	9.0	4.0	3.0
202 ALLOCATIONS	9.0	5.0	2.0
203 PREDICTIONS	3.0	1.0	1.0
204 FMECA	3.0	1.0	1.0
207 .2.1 PARTS CONTROL	9.0	4.0	2.0
207 .2.2 DESIGN GUIDELINES	7.0	4.0	1.0
208 RELIABILITY CRITICAL ITEMS	7.0	3.0	2.0
MAINTAINABILITY TASK			
101 MAINTAINABILITY PLAN	1.0	1.0	1.0
102 SUPPLIER CONTROL	1.0	1.0	1.0
103 PROGRAM REVIEWS	1.0	1.0	1.0
201 MODELING	9.0	7.0	3.0
202 ALLOCATIONS	9.0	7.0	3.0
203 PREDICTIONS	2.0	3.0	1.0
204 FMECA	9.0	9.0	5.0
205 MAINTAINABILITY ANALYSIS	2.0	5.0	3.0

CATSOP USE OF COMPUTED RANKING FACTOR

1. THE COMPUTED RANKING FACTOR IS TO BE USED FOR RANKING OF TASKS IF DESIRED BY THE USER.

2. THE COMPUTED RANKING VALUE IS ALSO TO BE USED TO ELIMINATE TASKS BASED ON BUDGET AS FOLLOWS:

    IF 11B (BUDGET IS LIMITED) ELIMINATE ALL TASKS WITH A RANKING OF 8 OR GREATER.

    IF 11C (BUDGET IS VERY LIMITED) ELIMINATE ALL TASKS WITH A RANKING OF 6 OR GREATER.

IV. LSA Update Task Selection Rules

The following rules/information deal with invoking the update sub-tasks of MIL-Standard 1388-1A as well as other issues related to previous effort accomplished.

BASIC PHILOSOPHY AND STRUCTURE

THE STRUCTURE OF MIL-STD-1388-1A IS SUCH THAT SOME TASKS HAVE "UPDATE" SUBTASKS. IN THESE INSTANCES; IF THE BASIC SUBTASKS HAVE BEEN PARTIALLY COMPLETED THE BASIC SUBTASK WILL NOT BE DIRECTED AGAIN. INSTEAD THE UPDATE SUBTASK WILL BE DIRECTED.

THE CATSOP TAILORING PHILOSOPHY IS TO USE THE TAILORING RULES TO DETERMINE IF A SUBTASK SHOULD BE PERFORMED. IF THE ANSWER TO QUESTIONS 19 AND/OR 20 IS THAT "IT HAS ALREADY BEEN COMPLETED" THIS INITIAL TAILORING WILL ELIMINATE THE TASK.

IF THE ANSWER TO 19 AND/OR 20 INDICATES THE SUBTASK HAS BEEN PARTIALLY COMPLETED THE UPDATE TASK WILL BE INVOKED IN PLACE OF THE ORIGINAL SUBTASK. THIS PACKAGE CONTAINS THE RULES FOR PERFORMING THIS SUBSTITUTION.

THESE RULES SHOULD BE INVOKED AFTER THE BASIC TAILORING HAS BEEN COMPLETED.

SOME TASKS DO NOT HAVE UPDATE SUBTASKS. IN THESE INSTANCES THEY ARE SHOWN BELOW WITH THE BASIC TASK IN THE UPDATE COLUMN AND MARKED WITH **. THIS HAS BEEN DONE TO ESTABLISH A NOTE WHICH IS TO BE INVOKED.

UPDATE SUBTASK SUBSTITUTION RULES

IF THIS QUESTION IS TRUE	AND THIS SUBTASK IS LISTED TO BE DONE	DO THIS LSA SUBTASK INSTEAD	AND INVOKE NOTES NUMBER:
19A2	201.2.1	201.2.4	14, 17
19B2	201.2.2	201.2.4	15, 17
19C2	201.2.3	201.2.4	16, 17
19D2	203.2.1	203.2.7	21
19E2	203.2.2	203.2.7	22
19F2	203.2.3	203.2.7	23
19G2	203.2.4	203.2.7	24
19H2	203.2.5	203.2.7	25
19I2	203.2.6	203.2.7	26
19J2	203.2.8	203.2.8**	27

UPDATE SUBTASK SUBSTITUTION RULES (Cont)

IF THIS QUESTION IS TRUE	AND THIS SUBTASK IS LISTED TO BE DONE	DO THIS LSA SUBTASK INSTEAD	AND INVOKE NOTES NUMBER:
20A2	201.2.1 - .4	201.2.4	17
20B2	202.2.1 - .4	202.2.1 - .4**	19
20C2	203.2.1 - .6	203.2.7	19
20C2	203.2.8	203.2.8**	27
20D2	204.2.1	204.2.2	19
20D2	204.2.3	204.2.3**	27
20E2	205.2.1 - 4	205.2.5	19
20F2	301.2.1 - 5	301.2.6	19
20F2	301.2.3	301.2.3**	27
20G2	302.2.1	302.2.2	19
20G2	302.2.3	302.2.4	19
20G2	302.2.5	302.2.5**	27
20H2	303.2.2 - 3	303.2.2 - 3**	19
20I2	501.2.1	501.2.1**	19

V. Input Data Consistency Check Rules

The following rules provide a limited check on the reasonableness of the answers provided by the user in a tailoring session.

1. If the program acquisition phase does not match the contract objective, Write:

Program Acquisition Phase and the Objective identified for this contract are not consistent with each other. Please change your answer to the Program Phase question to align it with the contract objective. This should be done even if that is different than the official program phase. Phase and corresponding Objectives are:

Pre-Concept Phase - Develop possible concepts to meet statement of need.

Concept Exploration Phase - Provide basis for selecting system which satisfies mission need and warrants further development.

Demonstration/Validation Phase - Verify conceptual results and define system sufficiently for detailed design.

Full Scale Development Phase - Detailed design, development, and qualification.

Production Phase - Produce and Deploy

2. If one or more of the following are true but at least one is false:

Reliability Specifications have been established.
Maintainability Specifications have been established.
Overall Logistics concepts, i.e. Deployment and Maintenance plans have been developed.

Write:
Data entered indicates that Reliability Specifications, Maintainability Specifications, or Overall Logistics concepts have been established but not all of them. Typically these factors are all established in the same process and CATSOP is not currently programed to differentiate between developing one or the other. Manual tailoring may be required.

3. If a catastrophic failure of the equipment will result in loss of life or a mission abort and, the hardware is a new design and, achievement of the reliability specifications will require significant emphasis and, the reliability budget is very limited:

Write:
The following type program has been described with a very limited reliability budget.

Critical Hardware (Loss of Life or Mission)
New Design
Achievement of reliability goals will require a significant emphasis.

It is suggested that program goals may not be achievable under these conditions with a very limited budget.

4. If a catastrophic failure of the equipment will result in loss of life or a mission abort and, the hardware is a new design and, achievement of the maintainability specifications will require significant emphasis and, the maintainability budget is very limited:

Write:
The following type program has been described with a very limited maintainability budget.

Critical Hardware (Loss of Life or Mission)
New Design
Achievement of Reliability Goals will require a significant emphasis.

It is suggested that program goals may not be achievable under these conditions with a very limited budget.

5. If a catastrophic failure of the equipment will result in loss of life or a mission abort and, the hardware is a new design and, the hardware will be used in a new application, and the LSA effort has had previous shortcomings and, the LSA budget is very limited:

Write:
The following type program has been described with a very limited LSA budget.

Critical Hardware (Loss of Life or Mission)
New design in a new application
LSA effort has previous shortcomings.

It is suggested that program goals may not be achievable under these conditions with a very limited budget.

APPENDIX E

R/M/L CATSOP LINKAGE RULES

APPENDIX E

R/M/L CATSOP LINKAGE RULES

This appendix is a Log of the R/M/L CATSOP Linkage rules. These rules define information relationships which exist between tasks. Each task of the three standards is listed on the left side of a rule(s) or "equation". The term on the right identifies the task(s) which provide information needed to complete the task on the left.

```
/* ------------------------------------------------------------------------ */
/* ----------------------------- LINKAGE KB ------------------------------- */
/* ------------------------------------------------------------------------ */
/*
   This file contains the facts that define the internal and external
   linkages between the standards that are being tailored.  Each fact
   is accessed using a task specification.
*/

/* --------------------------- linkage(TASK) ------------------------------- */

link-kb-linkage-nocache:              /* Prevent linkages from   */
nocache(linkage(TASK)).                  /*   being put into cache  */
link-kb-linkage-multivalued:          /* Allow each task to have */
multivalued(linkage(TASK)).              /*   multiple linkages     */
link-kb-linkage-noquestion:           /* Prevent prompting if no */
noautomaticquestion(linkage(TASK)).      /*   linkages exist        */

/*
   The following facts are the linkages for MIL-STD-1388-1a
   Logistic Support Analysis
*/

link-1-1:
linkage(std_1388_1a-201-2) = std_1388_1a-201-1.

link-1-2:
linkage(std_1388_1a-201-4) = std_1388_1a-201-1.
link-1-3:
linkage(std_1388_1a-201-4) = std_1388_1a-201-3.

link-1-4:
linkage(std_1388_1a-202-1) = std_1388_1a-201-4.

link-1-5:
linkage(std_1388_1a-202-3) = std_1388_1a-202-2.
```

```
link-1-6:
linkage(std_1388_1a-202-3) = std_1388_1a-202-1.

link-1-7:
linkage(std_1388_1a-202-4) = std_1388_1a-202-3.

link-1-8:
linkage(std_1388_1a-203-1) = std_1388_1a-201-4.

link-1-9:
linkage(std_1388_1a-203-2) = std_1388_1a-203-1.

link-1-10:
linkage(std_1388_1a-203-3) = std_1388_1a-203-2.

link-1-11:
linkage(std_1388_1a-203-4) = std_1388_1a-203-2.
link-1-12:
linkage(std_1388_1a-203-4) = std_1388_1a-203-3.

link-1-13:
linkage(std_1388_1a-203-5) = std_1388_1a-203-3.
link-1-14:
linkage(std_1388_1a-203-5) = std_1388_1a-203-2.
link-1-15:
linkage(std_1388_1a-203-5) = std_1388_1a-203-4.

link-1-16:
linkage(std_1388_1a-203-8) = std_1388_1a-203-2.
link-1-17:
linkage(std_1388_1a-203-8) = std_1388_1a-203-4.
link-1-18:
linkage(std_1388_1a-203-8) = std_1388_1a-203-6.
link-1-19:
linkage(std_1388_1a-203-8) = std_1388_1a-203-3.
link-1-20:
linkage(std_1388_1a-203-8) = std_1388_1a-203-5.

link-1-21:
linkage(std_1388_1a-204-1) = std_1388_1a-203-3.
link-1-22:
linkage(std_1388_1a-204-1) = std_1388_1a-203-4.

link-1-23:
linkage(std_1388_1a-204-2) = std_1388_1a-203-4.

link-1-24:
linkage(std_1388_1a-204-3) = std_1388_1a-204-1.
```

```
link-1-25:
linkage(std_1388_1a-205-2) = std_1388_1a-205-1.

link-1-26:
linkage(std_1388_1a-205-3) = std_1388_1a-205-1.

link-1-27:
linkage(std_1388_1a-205-4) = std_1388_1a-205-3.

link-1-28:
linkage(std_1388_1a-301-2) = std_1388_1a-301-1.

link-1-29:
linkage(std_1388_1a-301-3) = std_1388_1a-301-1.

link-1-30:
linkage(std_1388_1a-301-4) = std_1388_1a-301-1.
link-1-31:
linkage(std_1388_1a-301-4) = std_785b-204.

link-1-32:
linkage(std_1388_1a-301-5) = std_1388_1a-301-2.
link-1-33:
linkage(std_1388_1a-301-5) = std_1388_1a-301-4.
link-1-34:
linkage(std_1388_1a-301-5) = std_1388_1a-301-1.

link-1-35:
linkage(std_1388_1a-301-6) = std_785b-204.

link-1-36:
linkage(std_1388_1a-302-1) = std_1388_1a-301-1.
link-1-37:
linkage(std_1388_1a-302-1) = std_1388_1a-301-2.
link-1-38:
linkage(std_1388_1a-302-1) = std_470a-205.
link-1-39:
linkage(std_1388_1a-302-1) = std_470a-203.
link-1-40:
linkage(std_1388_1a-302-1) = std_1388_1a-205-3.
link-1-41:
linkage(std_1388_1a-302-1) = std_785b-203.

link-1-42:
linkage(std_1388_1a-302-2) = std_1388_1a-205-5.
link-1-43:
linkage(std_1388_1a-302-2) = std_1388_1a-301-6.
link-1-44:
linkage(std_1388_1a-302-2) = std_470a-205.
```

```
link-1-45:
linkage(std_1388_1a-302-2) = std_470a-203.
link-1-46:
linkage(std_1388_1a-302-2) = std_785b-203.

link-1-47:
linkage(std_1388_1a-302-3) = std_1388_1a-302-1.
link-1-48:
linkage(std_1388_1a-302-3) = std_470a-203.
link-1-49:
linkage(std_1388_1a-302-3) = std_1388_1a-301-2.
link-1-50:
linkage(std_1388_1a-302-3) = std_1388_1a-205-3.
link-1-51:
linkage(std_1388_1a-302-3) = std_470a-205.
link-1-52:
linkage(std_1388_1a-302-3) = std_785b-203.

link-1-53:
linkage(std_1388_1a-302-4) = std_1388_1a-301-6.
link-1-54:
linkage(std_1388_1a-302-4) = std_1388_1a-205-5.
link-1-55:
linkage(std_1388_1a-302-4) = std_470a-205.
link-1-56:
linkage(std_1388_1a-302-4) = std_470a-203.
link-1-57:
linkage(std_1388_1a-302-4) = std_785b-203.

link-1-58:
linkage(std_1388_1a-302-5) = std_1388_1a-302-3.
link-1-59:
linkage(std_1388_1a-302-5) = std_1388_1a-302-1.

link-1-60:
linkage(std_1388_1a-303-2) = std_1388_1a-205-3.
link-1-61:
linkage(std_1388_1a-303-2) = std_1388_1a-303-1.
link-1-62:
linkage(std_1388_1a-303-2) = std_1388_1a-205-2.
link-1-63:
linkage(std_1388_1a-303-2) = std_470a-203.
link-1-64:
linkage(std_1388_1a-303-2) = std_470a-205.
link-1-65:
linkage(std_1388_1a-303-2) = std_785b-203.

link-1-66:
linkage(std_1388_1a-303-3) = std_1388_1a-205-3.
```

```
link-1-67:
linkage(std_1388_1a-303-3) = std_1388_1a-303-1.
link-1-68:
linkage(std_1388_1a-303-3) = std_1388_1a-205-2.
link-1-69:
linkage(std_1388_1a-303-3) = std_470a-203.
link-1-70:
linkage(std_1388_1a-303-3) = std_470a-205.
link-1-71:
linkage(std_1388_1a-303-3) = std_785b-203.

link-1-72:
linkage(std_1388_1a-303-4) = std_1388_1a-205-3.
link-1-73:
linkage(std_1388_1a-303-4) = std_1388_1a-303-1.
link-1-74:
linkage(std_1388_1a-303-4) = std_1388_1a-205-2.
link-1-75:
linkage(std_1388_1a-303-4) = std_470a-203.
link-1-76:
linkage(std_1388_1a-303-4) = std_470a-205.
link-1-77:
linkage(std_1388_1a-303-4) = std_785b-203.

link-1-78:
linkage(std_1388_1a-303-5) = std_1388_1a-205-3.
link-1-79:
linkage(std_1388_1a-303-5) = std_1388_1a-303-1.
link-1-80:
linkage(std_1388_1a-303-5) = std_1388_1a-205-2.
link-1-81:
linkage(std_1388_1a-303-5) = std_470a-203.
link-1-82:
linkage(std_1388_1a-303-5) = std_470a-205.
link-1-83:
linkage(std_1388_1a-303-5) = std_785b-203.

link-1-84:
linkage(std_1388_1a-303-6) = std_1388_1a-205-3.
link-1-85:
linkage(std_1388_1a-303-6) = std_1388_1a-303-1.
link-1-86:
linkage(std_1388_1a-303-6) = std_1388_1a-205-2.
link-1-87:
linkage(std_1388_1a-303-6) = std_470a-203.
link-1-88:
linkage(std_1388_1a-303-6) = std_470a-205.
link-1-89:
linkage(std_1388_1a-303-6) = std_785b-203.
```

```
link-1-90:
linkage(std_1388_1a-303-7) = std_1388_1a-205-3.
link-1-91:
linkage(std_1388_1a-303-7) = std_1388_1a-303-1.
link-1-92:
linkage(std_1388_1a-303-7) = std_1388_1a-205-2.
link-1-93:
linkage(std_1388_1a-303-7) = std_470a-203.
link-1-94:
linkage(std_1388_1a-303-7) = std_470a-205.
link-1-95:
linkage(std_1388_1a-303-7) = std_785b-203.

link-1-96:
linkage(std_1388_1a-303-8) = std_1388_1a-205-3.
link-1-97:
linkage(std_1388_1a-303-8) = std_1388_1a-303-1.
link-1-98:
linkage(std_1388_1a-303-8) = std_1388_1a-205-2.
link-1-99:
linkage(std_1388_1a-303-8) = std_470a-203.
link-1-100:
linkage(std_1388_1a-303-8) = std_470a-205.
link-1-101:
linkage(std_1388_1a-303-8) = std_785b-203.

link-1-102:
linkage(std_1388_1a-303-9) = std_1388_1a-205-3.
link-1-103:
linkage(std_1388_1a-303-9) = std_1388_1a-303-1.
link-1-104:
linkage(std_1388_1a-303-9) = std_1388_1a-205-2.
link-1-105:
linkage(std_1388_1a-303-9) = std_470a-203.
link-1-106:
linkage(std_1388_1a-303-9) = std_470a-205.
link-1-107:
linkage(std_1388_1a-303-9) = std_785b-203.

link-1-108:
linkage(std_1388_1a-303-10) = std_1388_1a-205-3.
link-1-109:
linkage(std_1388_1a-303-10) = std_1388_1a-303-1.
link-1-110:
linkage(std_1388_1a-303-10) = std_1388_1a-205-2.
link-1-111:
linkage(std_1388_1a-303-10) = std_470a-203.
```

```
link-1-112:
linkage(std_1388_1a-303-10) = std_470a-205.
link-1-113:
linkage(std_1388_1a-303-10) = std_785b-203.

link-1-114:
linkage(std_1388_1a-303-11) = std_1388_1a-205-3.
link-1-115:
linkage(std_1388_1a-303-11) = std_1388_1a-303-1.
link-1-116:
linkage(std_1388_1a-303-11) = std_1388_1a-205-2.
link-1-117:
linkage(std_1388_1a-303-11) = std_470a-203.
link-1-118:
linkage(std_1388_1a-303-11) = std_470a-205.
link-1-119:
linkage(std_1388_1a-303-11) = std_785b-203.

link-1-120:
linkage(std_1388_1a-303-12) = std_1388_1a-205-3.
link-1-121:
linkage(std_1388_1a-303-12) = std_1388_1a-303-1.
link-1-122:
linkage(std_1388_1a-303-12) = std_1388_1a-205-2.
link-1-123:
linkage(std_1388_1a-303-12) = std_470a-203.
link-1-124:
linkage(std_1388_1a-303-12) = std_470a-205.
link-1-125:
linkage(std_1388_1a-303-12) = std_785b-203.

link-1-126:
linkage(std_1388_1a-401-1) = std_1388_1a-301-4.

link-1-127:
linkage(std_1388_1a-401-2) = std_1388_1a-401-1.

link-1-128:
linkage(std_1388_1a-401-3) = std_1388_1a-401-1.

link-1-129:
linkage(std_1388_1a-401-4) = std_1388_1a-401-1.

link-1-130:
linkage(std_1388_1a-401-5) = std_1388_1a-401-1.

link-1-131:
linkage(std_1388_1a-401-6) = std_1388_1a-401-3.
```

```
link-1-132:
linkage(std_1388_1a-401-7) = std_1388_1a-401-1.

link-1-133:
linkage(std_1388_1a-401-8) = std_1388_1a-401-1.

link-1-134:
linkage(std_1388_1a-401-9) = std_1388_1a-401-1.

link-1-135:
linkage(std_1388_1a-401-10) = std_1388_1a-401-2.

link-1-136:
linkage(std_1388_1a-402-2) = std_1388_1a-402-1.

link-1-137:
linkage(std_1388_1a-402-3) = std_1388_1a-402-1.
link-1-138:
linkage(std_1388_1a-402-3) = std_1388_1a-401-3.

link-1-139:
linkage(std_1388_1a-402-4) = std_1388_1a-303-11.
link-1-140:
linkage(std_1388_1a-402-4) = std_1388_1a-402-1.

link-1-141:
linkage(std_1388_1a-402-5) = std_1388_1a-402-4.
link-1-142:
linkage(std_1388_1a-402-5) = std_1388_1a-402-1.
link-1-143:
linkage(std_1388_1a-402-5) = std_1388_1a-402-6.
link-1-144:
linkage(std_1388_1a-402-5) = std_1388_1a-402-2.
link-1-145:
linkage(std_1388_1a-402-5) = std_1388_1a-402-3.

link-1-146:
linkage(std_1388_1a-403-1) = std_1388_1a-402-3.

link-1-147:
linkage(std_1388_1a-501-1) = std_1388_1a-205-2.

link-1-148:
linkage(std_1388_1a-501-2) = std_1388_1a-501-1.

link-1-149:
linkage(std_1388_1a-501-3) = std_1388_1a-501-2.
```

```
link-l-150:
linkage(std_1388_1a-501-4) = std_1388_1a-501-1.

link-l-151:
linkage(std_1388_1a-501-5) = std_1388_1a-501-4.
link-l-152:
linkage(std_1388_1a-501-5) = std_1388_1a-501-3.
link-l-153:
linkage(std_1388_1a-501-5) = std_1388_1a-501-1.

/*
   The following facts are the linkages for MIL-STD-470a
   Maintainability
*/

link-m-1:
linkage(std_470a-102) = std_1388_1a-303-2.
link-m-2:
linkage(std_470a-102) = std_470a-202.

link-m-3:
linkage(std_470a-104) = std_470a-202.

link-m-4:
linkage(std_470a-201) = std_1388_1a-303-2.
link-m-5:
linkage(std_470a-201) = std_785b-203.

link-m-6:
linkage(std_470a-202) = std_470a-201.
link-m-7:
linkage(std_470a-202) = std_785b-203.

link-m-8:
linkage(std_470a-203) = std_785b-203.
link-m-9:
linkage(std_470a-203) = std_470a-202.
link-m-10:
linkage(std_470a-203) = std_470a-201.
link-m-11:
linkage(std_470a-203) = std_1388_1a-401-1.

link-m-12:
linkage(std_470a-204) = std_785b-204.
link-m-13:
linkage(std_470a-204) = std_785b-203.
link-m-14:
linkage(std_470a-204) = std_470a-205.
```

```
link-m-15:
linkage(std_470a-205) = std_1388_1a-303-3.
link-m-16:
linkage(std_470a-205) = std_1388_1a-303-7.
link-m-17:
linkage(std_470a-205) = std_470a-203.
link-m-18:
linkage(std_470a-205) = std_470a-202.
link-m-19:
linkage(std_470a-205) = std_1388_1a-303-2.

link-m-20:
linkage(std_470a-206) = std_1388_1a-303-3.
link-m-21:
linkage(std_470a-206) = std_470a-203.
link-m-22:
linkage(std_470a-206) = std_470a-202.
link-m-23:
linkage(std_470a-206) = std_1388_1a-303-3.

link-m-24:
linkage(std_470a-301) = std_1388_1a-303-2.
link-m-25:
linkage(std_470a-301) = std_1388_1a-401-1.
link-m-26:
linkage(std_470a-301) = std_785b-204.
link-m-27:
linkage(std_470a-301) = std_470a-203.

/*
   The following facts are the linkages for MIL-STD-785b
   Reliability
*/

link-r-1:
linkage(std_785b-103) = std_785b-202.

link-r-2:
linkage(std_785b-105) = std_785b-202.

link-r-3:
linkage(std_785b-202) = std_785b-201.

link-r-4:
linkage(std_785b-203) = std_785b-202.
link-r-5:
linkage(std_785b-203) = std_785b-201.
```

```
link-r-6:
linkage(std_785b-204) = std_785b-203.

link-r-7:
linkage(std_785b-205) = std_785b-204.

link-r-8:
linkage(std_785b-206) = std_785b-207-2.

link-r-9:
linkage(std_785b-207-2) = std_785b-202.
link-r-10:
linkage(std_785b-207-2) = std_785b-203.

link-r-11:
linkage(std_785b-208) = std_785b-204.

link-r-12:
linkage(std_785b-209) = std_785b-202.
link-r-13:
linkage(std_785b-209) = std_1388_1a-303-2.

link-r-14:
linkage(std_785b-301) = std_785b-202.
link-r-15:
linkage(std_785b-301) = std_785b-104.

link-r-16:
linkage(std_785b-302) = std_785b-202.
link-r-17:
linkage(std_785b-302) = std_785b-104.

link-r-18:
linkage(std_785b-303) = std_785b-202.
link-r-19:
linkage(std_785b-303) = std_785b-104.

link-r-20:
linkage(std_785b-304) = std_785b-202.
link-r-21:
linkage(std_785b-304) = std_785b-104.

/* ------------------------------------------------------------------------ */

link-kb-loaded-flag:     /* Flag designating state of LINKAGE KB */
  linkages-loaded = yes.
```

APPENDIX F

CONTRIBUTING PERSONEL

CONTRIBUTING PERSONNEL

The basic concept of CATSOP and Artificial Intelligence/Expert Systems is to capture the consensus of experts such that non-experts can utilize it for decision making. Experts from Reliability, Maintainability, Logistics Support Analysis, Diagnostics Development, Integrated Logistics, Life Cycle Cost, Artificial Intelligence, Computer Mechanization & Interfaces and Software Development provided input and/or review functions for this project.

A brief summary of the personal histories of these key individuals is provided.

Name	Speciality
Robin Webster	Artificial Intelligence
Richard Davis	Reliability
F. Robert Hall	Reliability
David Hamilton	Reliability
Kei Yamane	Reliability
Jim Atkinson	Logistics Support Analysis
George Garcia	Logistics Support Analysis
Keith Gibson	R, M & LSA
Jim Portzer	Maintainability

To provide additional expertise in the field of Reliability, a contract was established with Sohar, Inc of La Jolla, California. This company was highly rated and provided added insight and knowledge to the program.

Robin Webster
Artificial Intelligence

Ms. Webster is Lead Engineer for the Artificial Intelligence/ Automation group. She is in charge of an IR&D project to apply expert systems to integrated diagnostics. She has been involved in the design and development of an in-house expert system tool called DORIS (Diagnostic Oriented Rockwell Intelligent System). DORIS is a framed inference system and knowledge base development environment.

Ms. Webster also participated on the CEPS (Cits Expert Parameter System) project as a software and knowledge engineer. CEPS is an expert system that performs diagnostics for the B-1B aircraft. The CEPS knowledge base was developed on a Symbolics computer using the KEE expert system shell. She is familiar with various expert system development tools and has taught in-house classes in the use of KEE.

Other experience includes writing ATLAS subroutines and FORTRAN device handling software for the B-1B RDAC (Remote Data Acquisition Cart) program. This software was used during post-assembly check-out of the B-1B aircraft.

Ms. Webster holds a BS degree in Computer Science from California State University.

Richard Davis
Reliability

Currently the lead engineer for the reliability design analysis unit. In this capacity he has directed the reliability analysis effort for various Rockwell programs including GPS, DSC, B-1B, and MATS. Before his current assignment with reliability, Mr. Davis was assigned to the Minuteman EMP test program. As a member of a field test team, he was responsible for the on-site evaluation of test environment and weapon system response.

F. Robert Hall
Reliability

Mr. Hall has been engaged in advancing the design reliability technology of the electronic and electro-mechanical system products designed and built at the Anaheim facility. His reliability program experience spans inertial navigation products (Hounddog, Minuteman, A3J Vigilante, A10 Aircraft and Polaris), panels, controls and power controller products (B-1B), integrated avionic systems (F-111), and space electronics products (GPS and Space Shuttle).

In his current assignment, he is responsible for implementating the disciplines of Design Assurance on all deliverable hardware designed and developed within S&SED Space Electronics Engineering. The Design Assurance disciplines include reliability, parts and materials and processes control, maintainability, radiation hardening control and test, and safety.

David Hamilton
Reliability

Management of MIL-STD-785 reliability programs including performing/ evaluating new business proposals; establishing reliability programs; writing and disseminating reliability program plans and program bulletins; conducting/evaluating reliability predictions, failure mode effects analyses, reliability trade studies, worst-case circuit analyses, component evaluation; supporting formal and informal design reviews; and supporting failure reporting, analysis, and corrective action for production test programs.

Kei Yamane
Reliability

Kei Yamane is a Senior Engineer with 26 years of experience in Reliability Engineering. He has worked in Major Hi-Rel programs such as the Minuteman and the Space Shuttle. His reliability knowledge comprehensively includes program/part management, prediction and modeling, FRACAS, FMECA, reliability testing, and part application review. Mr. Yamane is currently the Reliability expert in Autonetics Sensors and Aircraft Systems Division supporting many unclassified and classified programs involving radar and sensor systems, digital anti-jamming system, mini-transceiver systems, and signal processing systems. He has a Top Secret clearance and holds a BSEE degree.

Jim Atkinson
Logistics Support Analysis

Mr. Atkinson has over 25 years of experience in systems engineering, aircraft maintenance, Logistics Support Analysis, Integrated Logistics Support and life cycle cost analysis. His recent assignments at Rockwell include ILS planning for the Peacekeeper Rail Garrison and Small ICBM programs; life cycle cost analysis for ICBM systems; LSA specialist for the CATSOP program, and development of business proposals for ICBM systems.

George Garcia
Logistics Support Analysis

As a Logistics Engineer, Mr. Garcia developed Logistics support concepts and LSA support requirements utilizing MIL-STD-1388-1A/2A. Responsible for the development of an Integrated Logistics Support Plan pertaining to Electromagnetic Pulse (EMP) equipment support requirements. Development of Maintainability (MIL-STD-470A) and Reliability (MIL-STD-2170) requirements pertaining to the conceptual phase of an electronic warfare system. Preparation of cost proposals relating to all facets of Logistics (training, technical publications, LSAR, provisioning, maintainability). Direct interface with domestic and foreign customer support requirements. Responsible for evaluating the support posture of a manufacturing facility's technology modernization program, recommending changes and implementation of enhanced support programs.

Keith Gibson
R, M, & LSA

Responsible for all Logistics aspects of contracts, proposals, and special studies related to Integrated Logistics Support (ILS), Life Cycle Cost (LCC), Logistics Support Analysis, and Maintainability. Responsibility has been as a manager, team leader, responsible engineer, proposal book captain and engineer/analyst. As the Division's primary LCC expert, he managed/coordinated numerous activities dealing with RM&L. Direct responsibility has included modeling, maintainability, and LSA. However, Mr. Gibson has become intimately familiar with all reliability tasks as the result of utilizing their output products. He has an MBA in Operations Research and a BSEE degree.

Jim Portzer
Maintainability

Mr. Portzer is identified as the maintainability expert and contributes computer science counsel to the systems development. He is the maintainability engineer responsible for definition of maintenance concepts, fault isolation procedures, and calculation of quantitative and qualitative predictions to assure compliance with specification requirements. Plan and conduct demonstrations of achieved maintainability.

APPENDIX G

ACRONYM LIST

APPENDIX G

ACRONYM LIST

The following is a list of acronyms used in the R/M/L CATSOP user interface and the Final Report.

Acronym	Definition
AI	Artificial Intelligence
ASCII	American Standard Code for Information Interchange
CDRL	Contract Data Requirements List
DBDD	Data Base Design Document
FMEA	Failure Mode and Effects Analysis
FMECA	Failure Mode, Effects, and Critically Analysis
KB	Knowledge Base
LLCSC	Lower Level Computer Software components
LRA	Line Replaceable Assembly
LRU	Line Replacable Unit
LSA	Logistics Support Analysis
LSAR	Logistics Support Analysis Record
PC	Personal Computer
RADC	Rome Air Development Center
RFP	Request for Proposal
R/M/L CATSOP	Reliability, Maintainability, Logistics Support Analysis Computer Aided Tailoring Software Program
SDDD	Software Detailed Design Document
SOW	Statement of Work
SRA	Shop Replaceable Assembly
SRU	Shop Replaceable Unit
STLDD	Software Top Level Design Document
TLCSC	Top Level Computer Software Components
TRF	Task Ranking Factor
WRA	Weapons Replacable Assembly

MISSION
of
Rome Air Development Center

RADC plans and executes research, development, test and selected acquisition programs in support of Command, Control, Communications and Intelligence (C^3I) activities. Technical and engineering support within areas of competence is provided to ESD Program Offices (POs) and other ESD elements to perform effective acquisition of C^3I systems. The areas of technical competence include communications, command and control, battle management information processing, surveillance sensors, intelligence data collection and handling, solid state sciences, electromagnetics, and propagation, and electronic reliability/maintainability and compatibility.